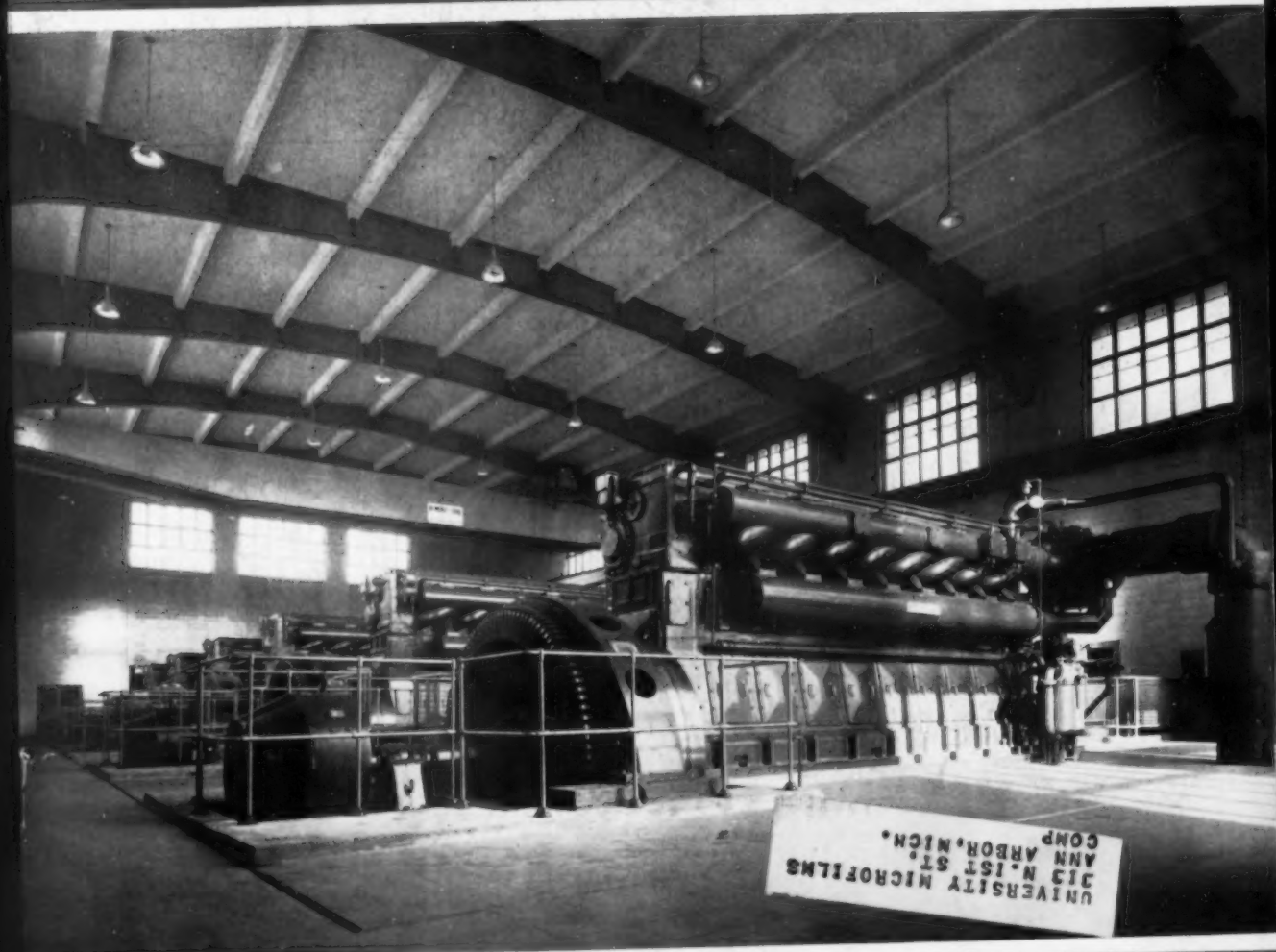
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL



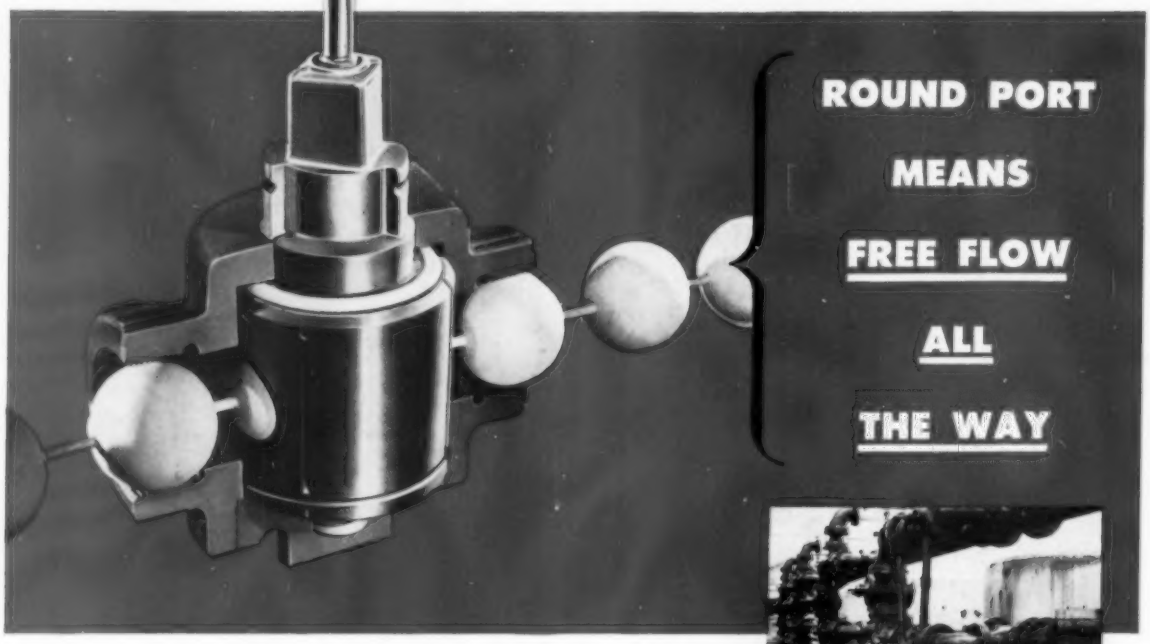
JUNE 1956

Six Superior Dual Fuel Diesels at Owls Head, N. Y.
(See Lead Article)

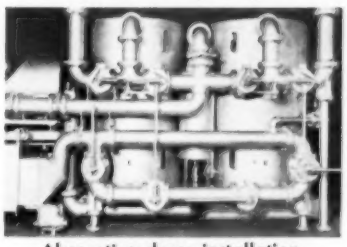
Fluosilicic Acid for Water Fluoridation

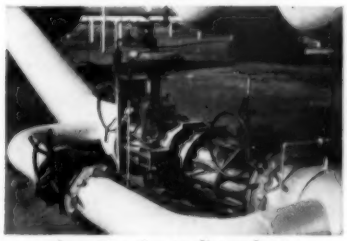
Relay Testing for Pump Motor Protection

ɑCf Lubricated Plug Valves



In salt water disposal plant.


Absorptive dryer installation.


In natural gasoline plant.

You get full volume, unrestricted flow throughout the entire piping system when you use ɑCf Round Port Valves.

The pipe-matching port openings cause no loss in head pressure—offer no more resistance to flow than the pipe itself. There are no obstructions—no turbulence and no harmful abrasive effects from solids in suspension. Even the most heavy viscous ladings flow freely through ɑCf Round Port Valves.

Split-second quarter-turn shutoff, non-wedging cylindrical plug, Teflon* head gasket, are additional advantages that add to perfect performance of ɑCf Round Port Valves—that mean extra long trouble-free service—lower maintenance costs and fewer work stoppages.

Act now to step up valve performance—to keep maintenance costs down. Representatives in 50 principal cities.

* DUPONT TRADE NAME

W-K-M MANUFACTURING COMPANY, INC.

A SUBSIDIARY OF ɑCf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS • MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURING

W-K-M THROUGH-CONDUIT GATE VALVES

ɑCf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

For permanent sewers...

IT PAYS TO STANDARDIZE ON CLAY PIPE

YSLETA, TEXAS is using Vitrified Clay Pipe *exclusively* in its million-dollar bond-financed sewerage improvement program. The County Water Control and Improvement District installed an extensive system of non-clay sewers in 1948, but has now *standardized entirely on Clay Pipe.* The reason? *Clay Pipe never wears out.* It's permanently safe against disintegration by hydrogen sulphide gas generated in all types of sewage —residential and industrial. Even when exposed to highly corrosive industrial waste, acids and alkalies, Clay Pipe serves for generations without the slightest sign of corrosion. And Clay Pipe is guaranteed for 50 years . . . valuable insurance for any bond-financed project. For sewers that *must be permanent,* always specify Vitrified Clay Pipe.

PROJECT: El Paso County Water Control and Improvement District No. 1

GENERAL MANAGER: Douglas E. Sopher

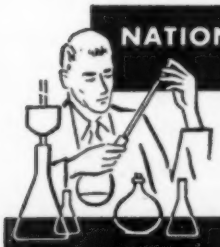
CONSULTING ENGINEERS: Ashley Closson & Associates

CONTRACTORS: T. N. O'Kelly; Jack Moore, Foreman

Vitrified

CLAY PIPE

CLAY PIPE NEVER WEARS OUT!



NATIONAL CLAY PIPE MANUFACTURERS, INC.
1820 N. Street, N.W., Washington 6, D. C.

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703 Ninth & Hill Bldg., Los Angeles 15, Calif.
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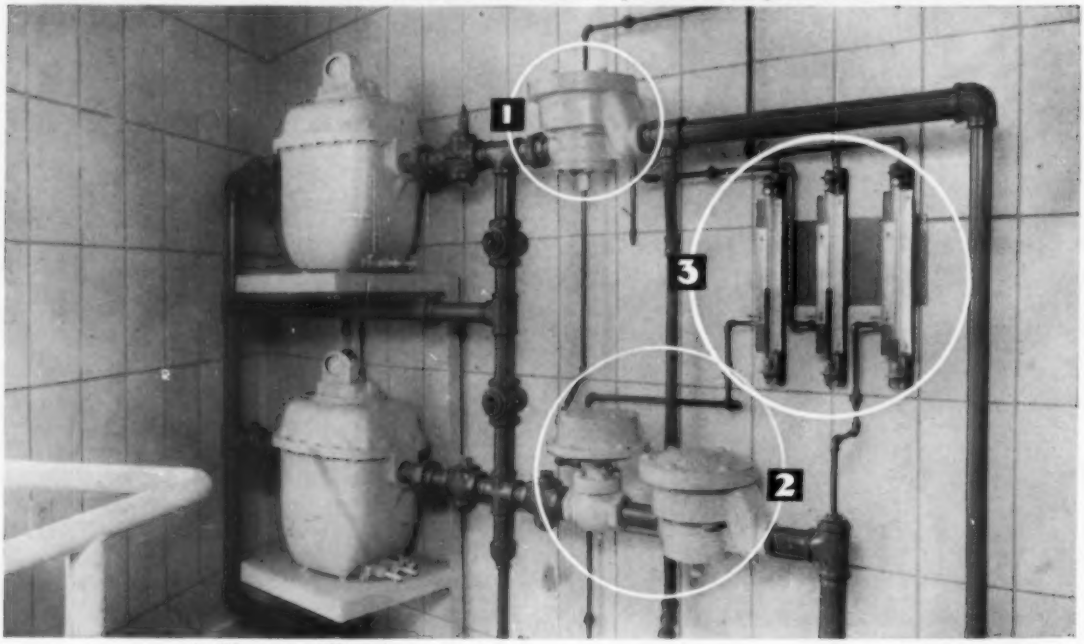
C-856-5

Progress in Public Health - Through Clay Pipe Research

PFT Gas Safety Equipment in the Control Building at the new Morris plant. See description below.



At Morris, Illinois...

A new plant equips for maximum protection

WITH PFT GAS SAFETY EQUIPMENT

The modern primary sewage treatment plant shown here began operations at Morris in March, 1955. Designed for a population of 9,600, it incorporates many features of "Controlled Digestion" in addition to a complete PFT gas safety system! Among the safety equipment items are:

(1) *PFT Flame Trap*—a heavy cast iron housing with aluminum flame arrester element prevents passage of flame. A thermal valve closes automatically at critical temperatures.

Plant Superintendent G. B. Reagen checks operation of the PFT #250 Heater & Heat Exchanger.

(2) *PFT Pressure Relief with Flame Trap*—the same flame trap features plus a pressure relief with diaphragm control. Maintains a safe, constant pressure at the digester and in the gas distribution system.

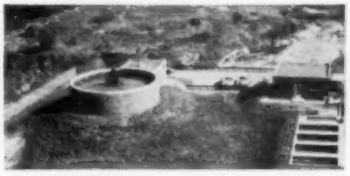
(3) *PFT Gas Pressure Gauge*—a 3 scale gauge indicates the pressure in various parts of the gas piping system. Top of gauge connects to vent manifold with flame checks.

PFT Drip Traps—four 2 qt. traps provide safe removal of condensate formed by warm gas passing through cooler piping.

Waste Gas Burner—an effective device that safely burns off all excess gas and prevents odor nuisance.

Additional equipment at the Morris plant includes: *PFT Floating Cover* for the 40′ digester; *PFT Heater & Heat Exchanger*; *PFT Supernatant Selector and Gauge* unit.

Morris' city officials and consulting engineers have created a fine plant that serves efficiently and economically. PFT is proud to have contributed its share to another modern sewage system.



Left, PFT Floating Cover on the 40′ digester. PFT prefabricated insulated roofing reduces digester heat losses.

Design of plant by / *Baxter & Woodman, Civil & Sanitary Engineers, Crystal Lake, Illinois*

waste treatment equipment exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

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Economic Evolution of Vacuum Sludge Filtration ..... *Mick & Linsley*
Selecting Valves for Water Service ..... *Paul*
Equipment Design to Obtain Highest Activated Sludge Efficiency .. *Kalinske*
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WATER AND SEWAGE WORKS is published monthly with an extra issue in June. Subscriptions including the Reference and Data issue in the U.S. and Canada, 1 year $3.00; 2 years $4.50; 3 years $6.00. Other countries $1.50 per year additional. Single copies 25c except Reference and Data issue 50c.

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"...started with a rented CLEVELAND in 1949 ...now we own ten"

SO SAYS HUBERT S. ELEY, vice president and general superintendent of D. A. Foster Trenching Corp., of Merrifield, Va. Today the firm, employing about 200 men in the field, keeps its 10 Clevelands (Models 95, 110 and 140), constantly busy on trenching jobs of all kinds. Further excerpts from Mr. Eley's report:

"...we encounter all types of soils and terrain ... swamps, sand, rock, shale, clay ... stumps, boulders and other obstructions ... hill and flat-land ... our Clevelands dig them all."

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"...we dig a gas or water house-connection in 15-20 minutes with one of our Clevelands."

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"...on building footings we dig 1,800-2,000 feet of 30" deep trench per day with a Cleveland."

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"...not necessary to stockpile large amounts of parts for Clevelands."

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"...fuel costs not a significant factor ... our Clevelands operate a working week on a tank of fuel."

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"...our Cleveland 140 paid for itself within 30 days."

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"...one of the many reasons we prefer Clevelands is their all-around adaptability ... besides our utilities work and footings contracts we use them for drainage trenching, septic tank installations and a wide range of other applications."

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"...we consider Clevelands the best all-purpose trenchers made ... the easiest to operate ... and the longest lasting."

Good Everywhere

THE CLEVELAND TRENCHER COMPANY

20100 St. Clair Avenue • Cleveland 17, Ohio

GIANT gravity-defying sentinels of high strength alloys, armed with nuclear weapons, may be able to hover near centers of aggression ready at an instant's notice to drop destruction that will make war too deadly to risk.

100 years from now...

WE MAY MAKE WAR IMPOSSIBLE!

Scientists, looking ahead, envisage a fabulous future...full of wonderful new products that will bring civilization a whole new era of progress. But, even then, our gas and water will still flow through the same dependable cast iron pipe being laid now.

Here's proof! Today, more than 60 American cities and towns are being efficiently served by the same cast iron water and gas mains laid over 100 years ago. What's more, modernized cast iron pipe...centrifugally cast and quality-controlled ...is even stronger, tougher, more serviceable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

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cast iron
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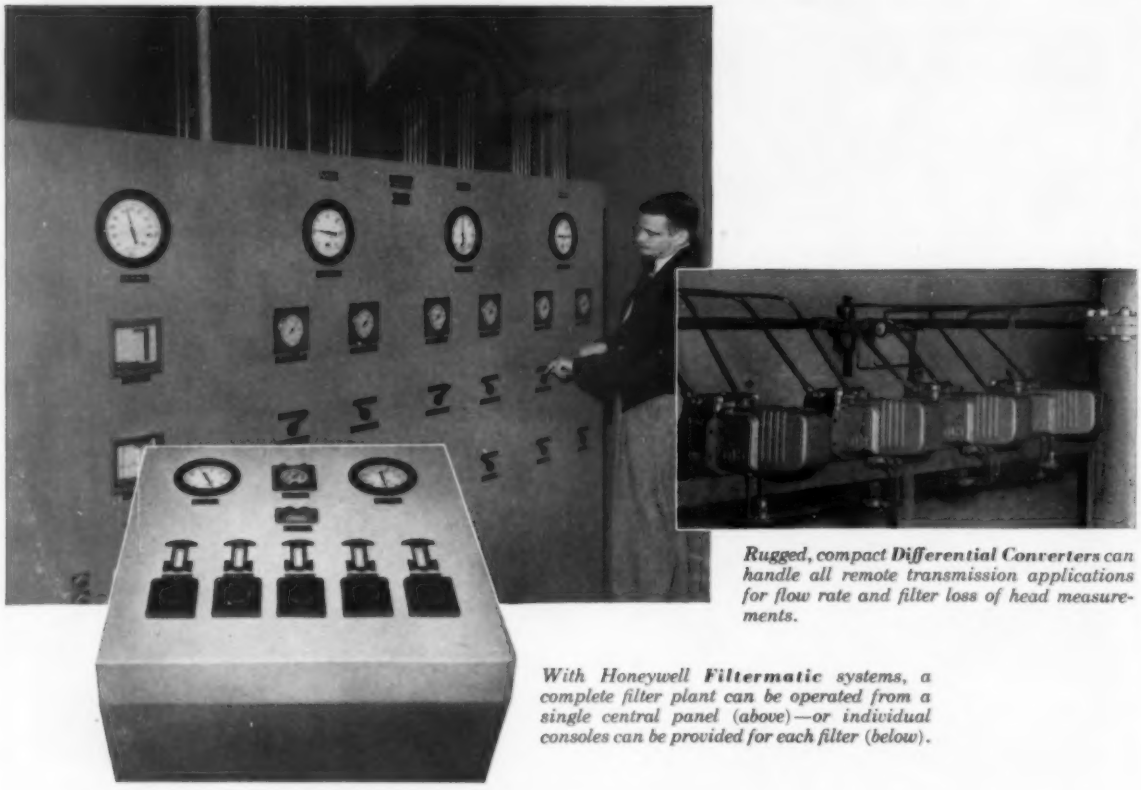
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.



Rugged, compact ***Differential Converters*** *can handle all remote transmission applications for flow rate and filter loss of head measurements.*

With Honeywell ***Filtermatic*** *systems, a complete filter plant can be operated from a single central panel (above)—or individual consoles can be provided for each filter (below).*

Honeywell *Filtermatic** Systems give you *centralized automatic* control of your filtration plant

YOU CAN put a new kind of operating economy and simplicity into your water filtration plant, with Honeywell *Filtermatic* systems. These modern filter control systems give you a unique combination of design, operating and maintenance features.

Flexible control. Filtration and backwashing can be regulated by any of a variety of methods, at the operator's discretion. He can choose manual, semi-automatic, or remote manual operation. Or he can have automatic control established by pre-set flow rates, clearwell level or water usage.

Flexible design. Free from limitations of cables and mechanical linkages, *Filtermatic* systems are easily designed into central control panels in laboratory or office. Or, individual operating consoles can be provided on the filter floor.

Simple installation. Components are compact . . . require less space in pipe gallery or on the operating floor. First cost is low, installation is easy on either new or existing filters.

Simple maintenance. Built of rugged elements, *Filtermatic* systems function continuously with minimum attention. Use of interchangeable units—the same *Differential Converter* transmitters, for instance, for level, flow rate, differential pressure—reduces spare parts requirements. The system uses clean, dry air, so pipe galleries stay clean and corrosion problems are reduced.

Ask your local Honeywell sales engineer to discuss your specific filter requirements . . . he's as near as your phone.

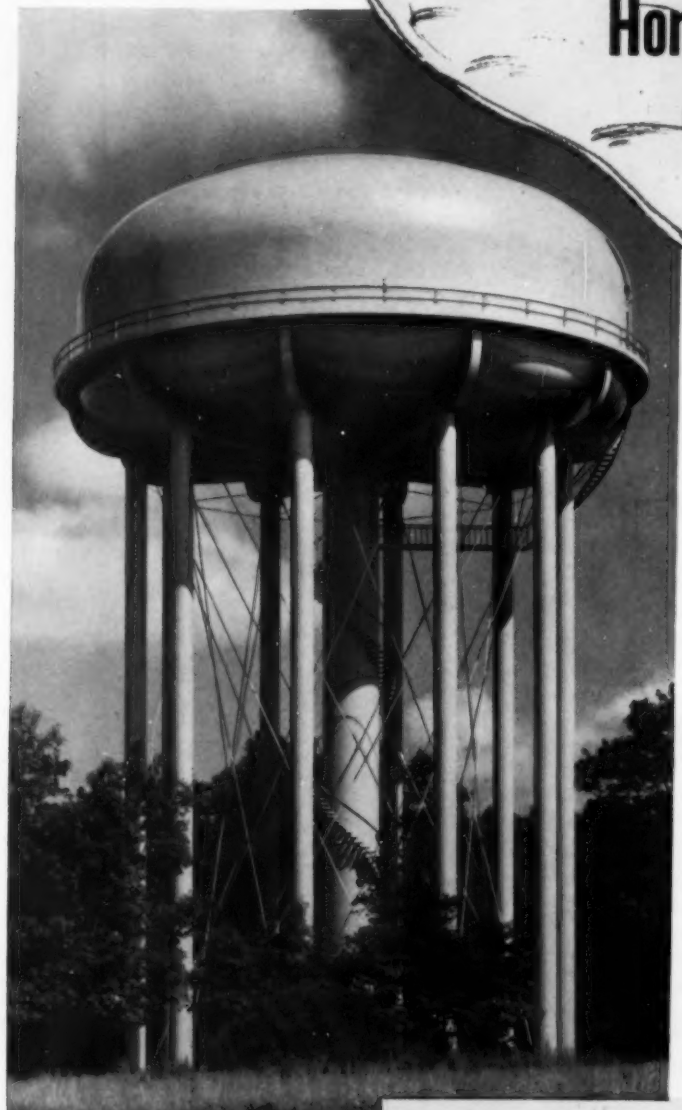
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

* Tradename of Minneapolis-Honeywell Regulator Co.

A Million Gallon Horton Tank

In the heart of tobacco land



Winston Salem, North Carolina, located in a region noted for tobacco growing and reported to turn out more manufactured tobacco products than any other city in the world, has a 1,000,000-gal. Horton® radial-cone elevated tank helping provide an efficient municipal water system. Storing water that will flow by dependable gravity pressure when needed, the Horton elevated tank helps increase minimum distribution pressure and decrease pressure variations during peak load periods.

Horton elevated tanks are built in standard sizes to 3,000,000 gallons. To find out the benefits such a tank can provide for your city, write the nearest Chicago Bridge & Iron Company office.

1,000,000-gallon Horton radial-cone tank at Winston Salem, N. C., with a range in head of 30 feet.

CBI

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HARVEY, ILLINOIS ENDS PROBLEM OF FLOODED BASEMENTS WITH

CONCRETE PIPE

To end a vexing problem of flooded basements in a large section of the city, Harvey, Ill. built a new relief concrete pipe storm and sanitary sewer. Both the old and the new sewer lines connect with the system of the Chicago Sanitary District at the north city limits.

The project used more than 40,000 ft. of concrete pipe 21 to 90 in. in diameter. It was financed by two bond issues—$675,000 in revenue bonds and $1,500,000 in general obligation bonds.

Like Harvey, hundreds of American cities depend on long-lasting concrete pipe sewer installations. These many systems have demonstrated concrete pipe's rugged durability, great structural strength, maximum hydraulic capacity, minimum infiltration and leakage, and unusual resistance to abrasion.

Concrete pipe sewers are moderate in first cost, require little maintenance and give lifetime service. The result is true ***low-annual-cost*** sewer service. Write for free 48-page booklet, *"Concrete Sewers,"* distributed only in the United States and Canada.

PORTLAND CEMENT ASSOCIATION

Dept. 6-29, 33 W. Grand Ave., Chicago 10, Ill.

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

TYLOX RUBBER PIPE JOINTS

Put BOULDER, COLORADO'S* new Irrigation Siphon ahead on 3 Major Counts . . .

★ MORE PIPE LAID PER DAY
★ COMPRESSION-TIGHT JOINTS
★ NO DETERIORATION

Making Joints with
TYLOX RUBBER GASKETS
is as simple as A B C

Cement tongue and snap on TYLOX Gasket. | Lubricate sliding surfaces with TYLOX Cement. | Shove the pipe home to line and grade.

Here's How—

Regardless of pipe size, Tylox Gaskets make it possible to lay pipe faster. Further, they eliminate costly delays as well. For instance, wet trenches can't slow up the work, and laid line may be backfilled immediately.

Rubber Tylox seals by *compression,* not adhesion. Its natural flexibility compensates for angularities in the line, or for soil stresses and surface loads. It stays tight, reducing maintenance by preventing ground water, sediment or roots from entering the line.

Sewerage and industrial waste acids have no effect on Tylox Joints. They are made of specially compounded rubber which is not subject to corrosion. Under ground, and under compression, Tylox Joints outlast the pipe itself.

Send for complete details and more case histories on TYLOX, the one pipe joint that meets the requirements of engineers, sanitary officials and construction men alike. Read the facts — and take advantage of TYLOX RUBBER JOINTS on your next concrete or vitrified clay pipe job.

* **PROJECT** — Ninth Avenue Irrigation Siphon, Farmer's Ditch Company, Boulder, Colorado.

PIPE — 48" reinforced concrete, manufactured by Western Concrete Pipe Company, Denver, Colorado.

ENGINEERS — Engineers of Soil Conservation Service, Boulder, Colorado.

CONTRACTOR — Hudson Construction Company, Boulder, Colorado.

FEATURE — Inverted Siphon, Maximum head, 44 ft.

1930

HAMILTON KENT MANUFACTURING COMPANY
KENT, OHIO
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May we quote on your requirements?

Write for our latest Elevated Tank Brochure

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MADRID, SPAIN . . . Diego DeLeon, 60

Which uses the most water?

Filling Station —or Church Building?

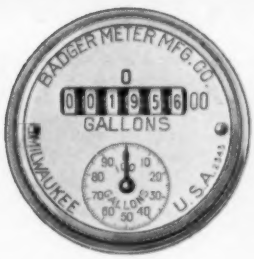
ANSWER: Before one Midwestern community installed water meters, gas stations were billed a flat rate of $12 per year; so were the churches. Last year, the average bill for all filling stations was $48, while in only one case did a church use more water than the minimum charge of $7.20.

Badger water meters provide fair rates for all users – help conserve vital resources – key to the future of your community.

The above is a typical example of how flat-rate water policies are annually depriving water departments of thousands of dollars of revenue. Is this practice — and the *water waste* that goes with it — a problem in your community?

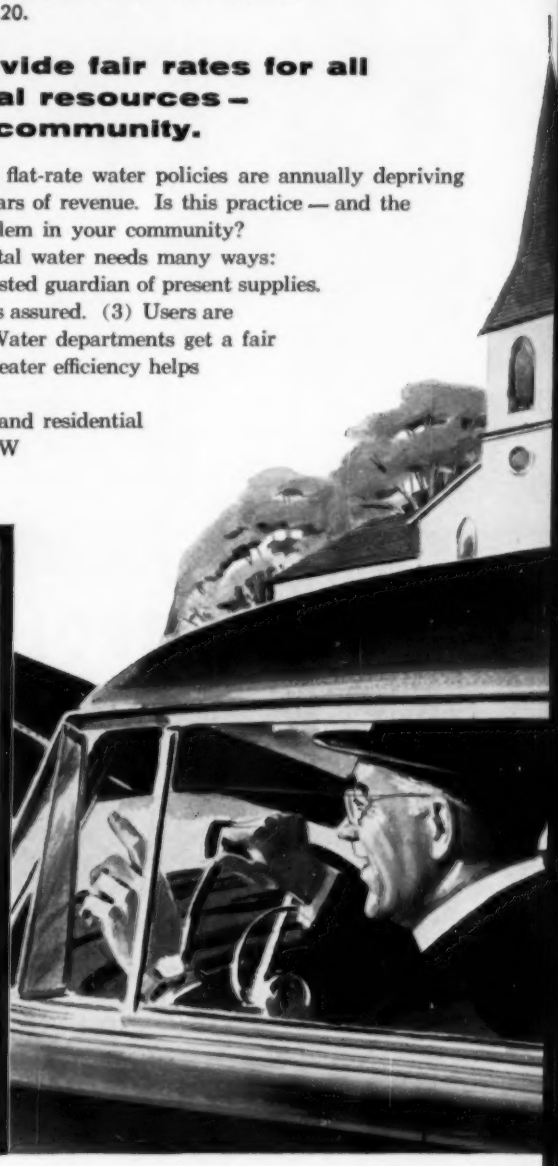
Studies show Badger meters serve vital water needs many ways: (1) Each customer becomes a self-interested guardian of present supplies. (2) A fair allotment of available water is assured. (3) Users are charged for exact amounts used. (4) Water departments get a fair price for water and service. And, (5) greater efficiency helps keep water departments self-supporting.

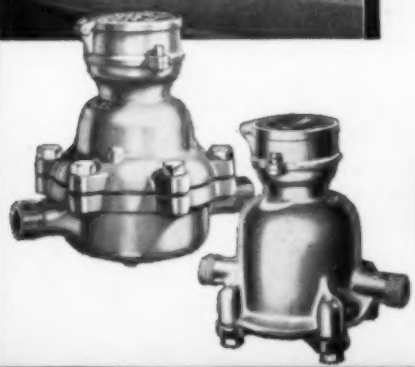
Water is vital to industrial, business and residential development. Make certain you act NOW to safeguard your community's future — specify Badger water meters.



Sensitive registering key to maximum revenue per installation

One of the greatest "business machines" your community can own. Badger water meters are always on duty. Dial accurately registers all flow from the smallest stream to maximum meter capacity. Service records also prove the dependability of Badger meters . . . show why waterworks men agree, "It pays to install Badger meters."





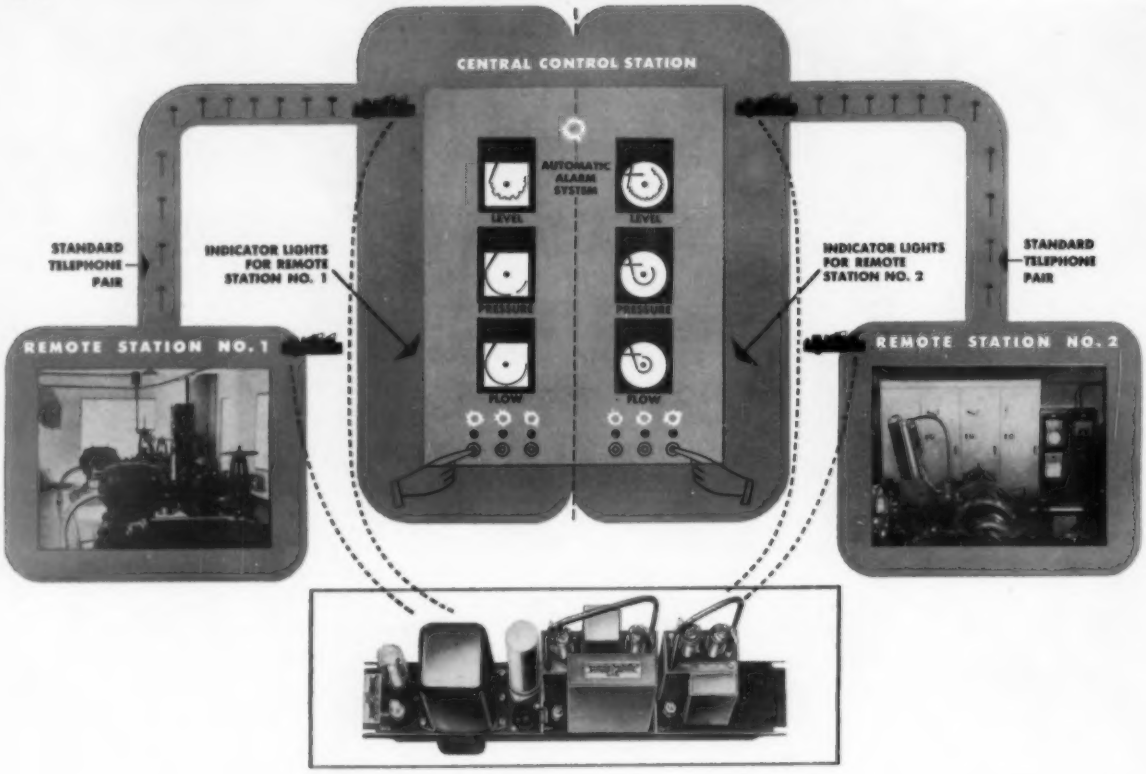
For complete details on how Badger meters can help your community save water, work and money, write us.

Badger Water Meters

Water is Vital

"Badger Meters have conserved it for 50 years"

BADGER METER MFG. CO. • MILWAUKEE 45, WISCONSIN



THE PRACTICAL METHOD OF CONTROLLING WATER SYSTEMS

Hammarlund COC equipment accomplishes reliable supervision of your entire water system from a single, central control location. It relieves operating personnel to perform more important work in maintaining high quality service to your customers.

Hammarlund COC equipment is rapidly becoming the key to economy with more and more water and sewage systems throughout the country. COC equipment costs are low. In most cases an installation will pay for itself in less than two years. It can be used with your present instruments, utilizing a standard telephone pair between points in the system with many functions being supervised, controlled, or telemetered simultaneously on a single pair of lines.

With the installation of a Hammarlund COC system you can supervise and record flow, pressure and level at all stations. In addition, by means of a central control board, you can start and stop pumps, proportionally open and close valves, or perform any other function directly from the central station usually requiring visits by personnel to outlying stations.

Versatility of the COC system is practically unlimited. Any number of stations can be covered, regardless of distance, while any number of measuring or control functions can be handled. The design of the Hammarlund COC system permits expansion at any future date without complications or re-engineering of the existing system. If need arises for radio-link communications between units, instead of a standard telephone pair, it may easily be accomplished utilizing the original equipment.

WRITE FOR BULLETIN WSW-656

HAMMARLUND Centralized Operations Control

HAMMARLUND MANUFACTURING COMPANY, INC.,
460 West 34th Street, New York 1, N. Y.
INTERNATIONAL DIVISION: 13 East 40th Street, New York 16, N.Y.

Established 1910

BRING ON YOUR RIVERS!

CLOW RIVER-CROSSING CAST IRON PIPE TAKES 'EM "IN STRIDE"!

EASY TO LAY. As easy to make up as a standard flanged joint. Lower labor installation cost because of ease of joint make-up and longer laying lengths.

ONLY A RATCHET WRENCH NEEDED. No split parts. Fewer parts—each joint consisting of one complete pipe, one solid follower ring, one solid ring gasket, bolts and nuts.

FULL 15° TURNING DEFLECTION with absolutely no reduction in the full internal opening area—therefore, no abnormal pressure-drops at deflected joints. Deflection stresses evenly distributed among all the bolts.

LONGER LAYING LENGTHS—approximately 18′6″—faster installation, lower costs. However, lengths may be varied to suit conditions. For example: 6 foot, 12 foot or other special lengths may be advisable to suit required curvature.

Mail coupon for complete information on Clow Ball-and-Socket River-Crossing Pipe. No obligation, naturally.

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Chicago 80, Illinois

Please send me, without obligation, details and specifications of Clow Ball-and-Socket River-Crossing Pipe.

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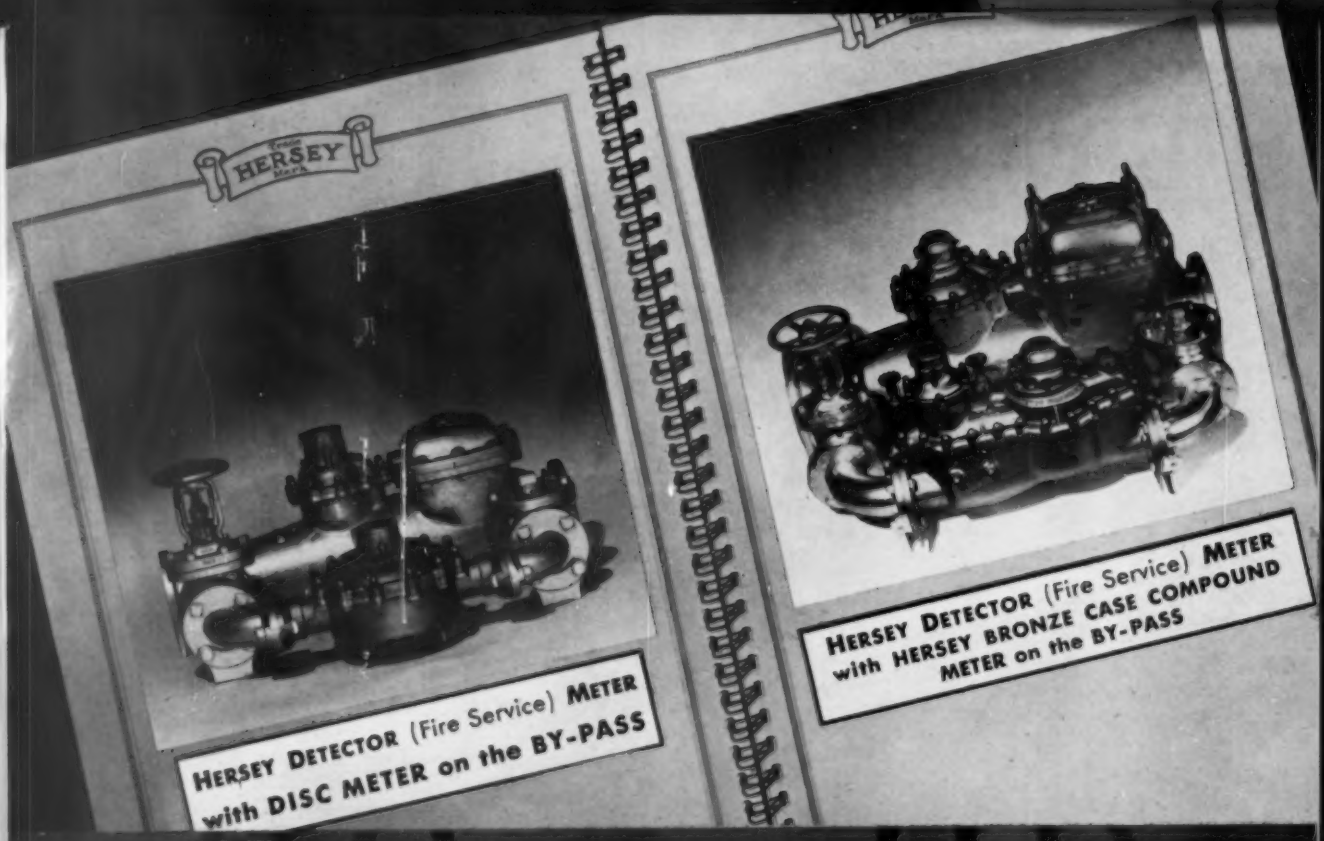
Street Address_____
City_____ **Zone**____ **State**_____
Individual's Name_____
Position_____


HERSEY
HERSEY DETECTOR (Fire Service) METER with DISC METER on the BY-PASS
HERSEY DETECTOR (Fire Service) METER with HERSEY BRONZE CASE COMPOUND METER on the BY-PASS

HERSEY DETECTOR (Fire Service) METERS

Listed as standard under the re-examination service of Underwriters' Laboratories, Inc. and approved by Factory Mutual Laboratories for use in Factory Mutual insured properties, also listed by Underwriters' Laboratories of Canada.

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
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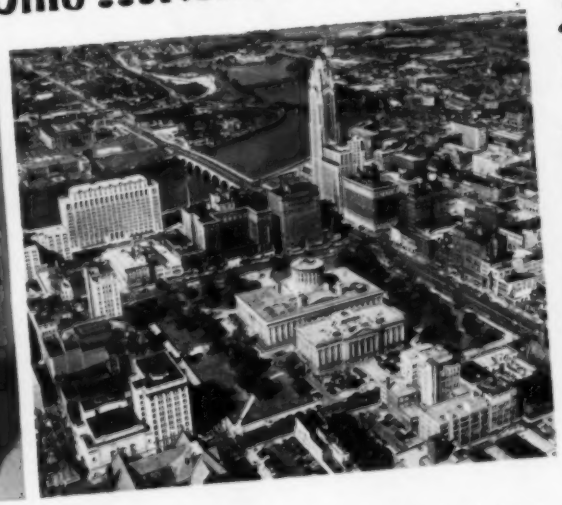
Columbus, Ohio ---Relies on Layne!



Capital city of the great state of Ohio, Columbus produces a wide variety of manufactured products . . . and graduates of five centers of higher learning. Among its 800 factories are General Motors, North American Aviation and Westinghouse Electric Corporation.

As Columbus grew, so did its demand for water, and to Layne was entrusted the development of the Nelson Road plant serving the eastern section of the city and capable of producing ten million gallons of water per day. Six Layne drilled wells and six Layne vertical turbine pumps are surety of an adequate supply of water for industry and home.

Columbus—and hundreds of other municipalities, large and small, know it is wise to rely on Layne for any service that relates to ground water development.

LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES
THROUGHOUT THE WORLD

Layne

Water Wells • Vertical Turbine Pumps • Water Treatment

6 TIMES MORE THAN WE NEED

MODERNIZED **cast iron**

RAINFALL ...still not enough!

No secret to you that water is America's No. 1 Problem... that rainfall is largely wasted, unevenly distributed or polluted.

But does the public know it?

It's important that the great mass of the American people learn the facts. We're helping there.

Month after month our national advertising stresses the need for long range planning of water facilities; public support for realistic water rates; necessary water works financing; conservation by homeowner and industry.

Our aim... like yours... is to alert the public to the growing seriousness of water shortages... enlist their cooperation so that we—and our children—will be assured of a plentiful supply of water for all our needs.

CAST IRON PIPE

proved by Performance

Over a hundred years ago cast iron pipe mains were laid by more than 70 American utilities. They're still working efficiently.

Here's proof of cast iron pipe's dependability and longevity... its savings in maintenance costs and tax dollars.

Today's modernized cast iron pipe, centrifugally cast for greater strength and uniformity, is even more durable. Where needed, it can be cement-lined for sustained carrying capacity through generations of hard use.

When you specify pipe for your water system, remember: no other pipe can match cast iron's *proved* record of performance. It serves for centuries.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Illinois.

This rugged old cast iron water main, laid 125 years ago, is serving and saving tax dollars for the citizens of Detroit, Michigan.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

'Red Water' doesn't live here any more!

No more 'Red Water'—thanks to Threshold Treatment with Calgon*—that's the record in this typical community.

When Calgon treatment was started, 'Red Water' stopped, and now everyone is complimenting the water superintendent.

Calgon in very small amounts is effective against 'Red Water' because it not only stabilizes iron and manganese dissolved in water at its source, but it also prevents iron pickup from pipes.

Calgon stops lime scale, too, by forcing calcium carbonate and other scale-forming chemicals to stay in solution, even when the water is heated. Calgon is used in minute amounts, and the reduction of lime scale means important savings in keeping equipment and meters clean.

Call on Calgon for the economical solution to your specific problem. Many years of experience with water problems of all kinds in every part of the country are at your service.

*Calgon is the Registered Trade Mark of Calgon, Inc. for its glassy phosphate (sodium hexametaphosphate) products.

HAGAN

calgon, inc.

A Subsidiary of Hagan Corporation
Hagan Building • Pittsburgh 30, Pa.

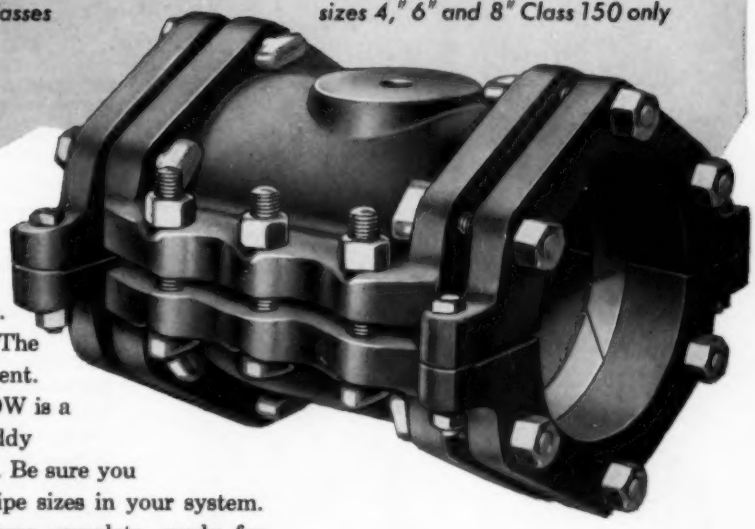
NOW from EDDY...

Mechanical Joint Split Sleeves

for repairing water mains...

CAST IRON MAINS
sizes 3" through 16" All Classes

ASBESTOS-CEMENT
sizes 4," 6" and 8" Class 150 only



Here's the fastest, most economical way to repair damaged water mains. Installation is a matter of minutes. The repair you make is positive, permanent. This is a reminder that RIGHT NOW is a good time to check your stock of Eddy mechanical joint split repair sleeves. Be sure you have some to match each of the pipe sizes in your system. Remember: Eddy repair sleeves come complete, ready for instant use, each with detailed instructions for installing . . . easily, quickly and with no tools other than a ratchet wrench. NOW is the time to order . . . or to mail the coupon if you'd like more information. No obligation, naturally.

Mail Coupon Now
for full facts

EDDY VALVE COMPANY

WATERFORD, NEW YORK

Eddy Valve Company
Waterford, N. Y.

Please send me complete information on Eddy Mechanical Joint Split Sleeves.
(please check which)

For: ☐ Cast iron ☐ Asbestos-cement

Name_____

Address_____

City_____ Zone____ State____

PUT EVERY OPERATION AT YOUR FINGERTIPS

...through Foxboro SUPERVISORY CONTROL

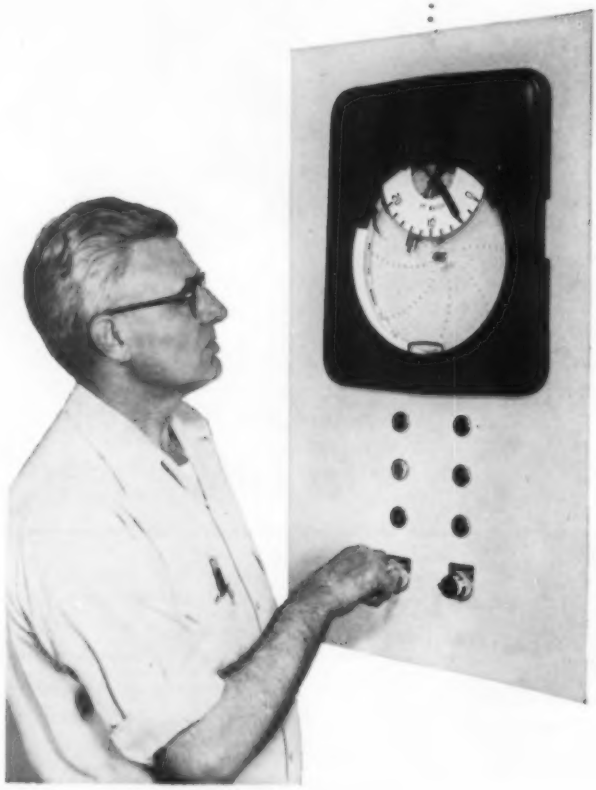
ANY TRANSMISSION SYSTEM
Two Wires
One Wire and Ground
Radio or Microwave
Carrier Current

EFFICIENT — Continuous, centralized control of the whole system by one operator.

ECONOMICAL — Simultaneous, two-way transmission over lowest-cost carrier systems.

SAFE — Confirming, "report-back" signals on all operations.

TROUBLE-FREE — Field-tested Foxboro quality throughout.



You can assure perfect coordination of all operations in water or sewage treatment plants with Teletax supervisory control. This modern, Foxboro System gives the supervisor continuous, centralized control of every flow rate, pressure, and level—no matter how distant or isolated. Measurements made with standard Foxboro Measuring Elements can be transmitted by Teletax over *any* transmission system. And any combination of manual or automatic indication and control can be provided. Each Teletax installation is engineered to meet the specific needs of the individual plant. Assure *your* operation highest efficiency and economy with Teletax. Write for complete details. The Foxboro Company, 896 Neponset Avenue, Foxboro, Mass., U.S.A.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
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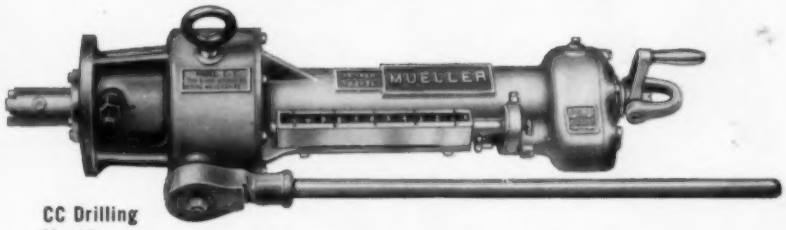
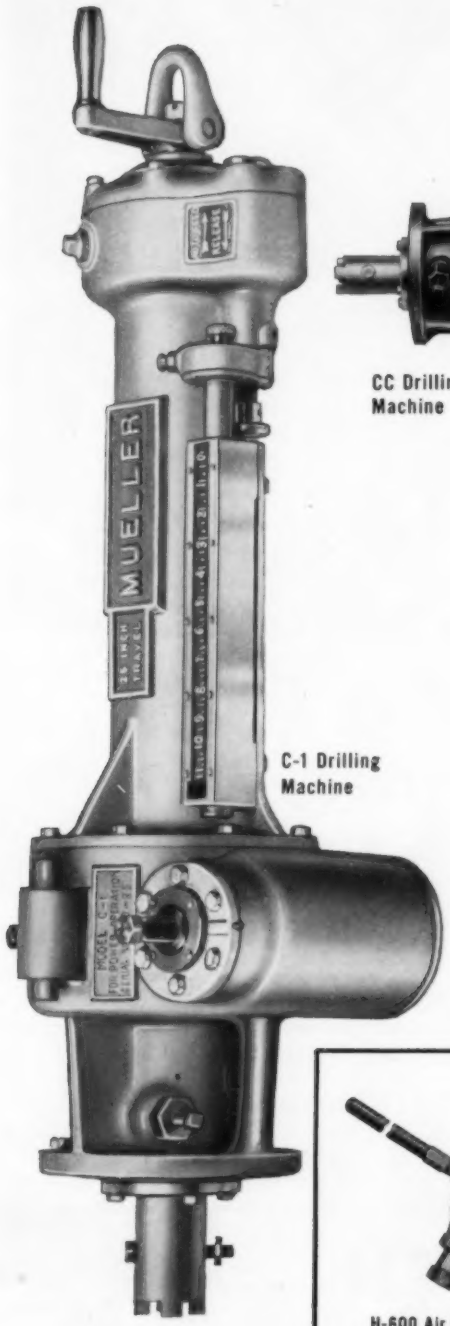
TELETAX TELEMETERING

MUELLER

Make cuts 2" through 12" in any kind of pipe!



CC Drilling Machine

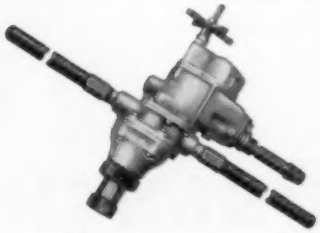


C-1 Drilling Machine

MUELLER Drilling Machines offer:

- 25" Boring bar travel
- Hand or power operation
- Air or gasoline power units
- Automatic or manual feed
- Standard feed indicator
- Pressures to 500 p.s.i. at 100° F.
- Temperatures to 500° F. at 250 p.s.i.

Install control valves, connect branch mains and make other water works installations – all under pressure.



H-600 Air Motor for use with C-1 Drilling Machine. H-602 gasoline drive unit also available.

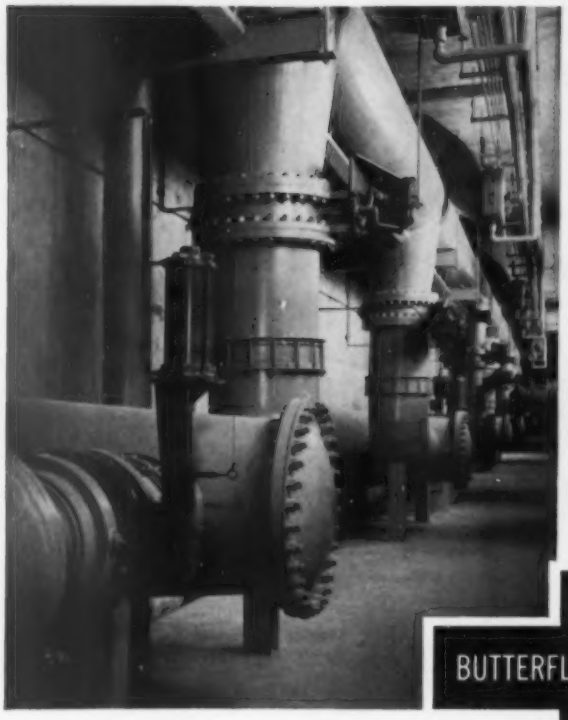
Contact your Mueller Representative or write direct for complete information.

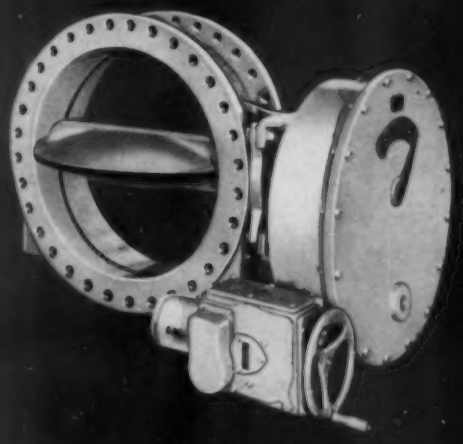
MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

DROP-TIGHT SHUTOFF R-S Rubber-Seated Butterfly Valves give drop-tight closure to 125 psig through wedge-type action of the disc within a one-piece rubber seat. 65 of these valves, installed as shown for service in the San Jacinto River project near Houston, gave a substantial space reduction and direct, in-place cash savings of $124,000.





FOR HIGH-PRESSURE SERVICE SMS Babbit-Seated Butterfly Valves are built to give tight shutoff and meet the rugged demands of high-pressure service. They are available for shutoff pressures up to 200 psig, and for a wide range of velocities, including open-end free discharge.

BUTTERFLY VALVES

GET POSITIVE SHUTOFF, CUT CONSTRUCTION COSTS

For high or low-pressure water service, SMS has the Butterfly Valve to give you tight shutoff and help reduce construction costs. Using SMS or R-S Butterfly Valves in place of conventional gate valves permits a much more compact piping layout, means substantial savings in the initial building costs. For full information on the complete SMS valve line – Butterfly Valves, Ball Valves and Rotovalves – see our local representative or write S. Morgan Smith Co., York, Pa.

HYDRAULIC TURBINES
GATES & HOISTS
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ROTOVALVES
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BALL VALVES
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BUTTERFLY VALVES

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED • TORONTO

helping to mix a good, clear drink for 5 years

The city of Denver has, for many years, been noted for the purity of its drinking water. Transported from the western slopes of the Rockies through the famous Moffat Tunnel, the water is purified in the Moffat Filter Plant of the Denver Municipal Water Works.

It is here that *flexible* U. S. Pilot Pipe plays an important role – carrying the chemicals that purify the water–maintaining what is known as a good P.H. factor. This U. S. Pilot Pipe installation has given completely trouble-free service since the day it was put in. That was back in 1950–over five years ago.

With ordinary piping, lime in the chemicals builds up and clogs the pipe. But because U. S. Pilot Pipe is flexible, lime is easily broken loose by merely *tapping or walking the pipe!*

"U. S." specializes in products to handle corrosive chemicals and acids. These problems usually can be solved by such "U. S." products as Pilot Pipe, Uscolite®, Tank Linings, and Permobond® protective rubber lining.

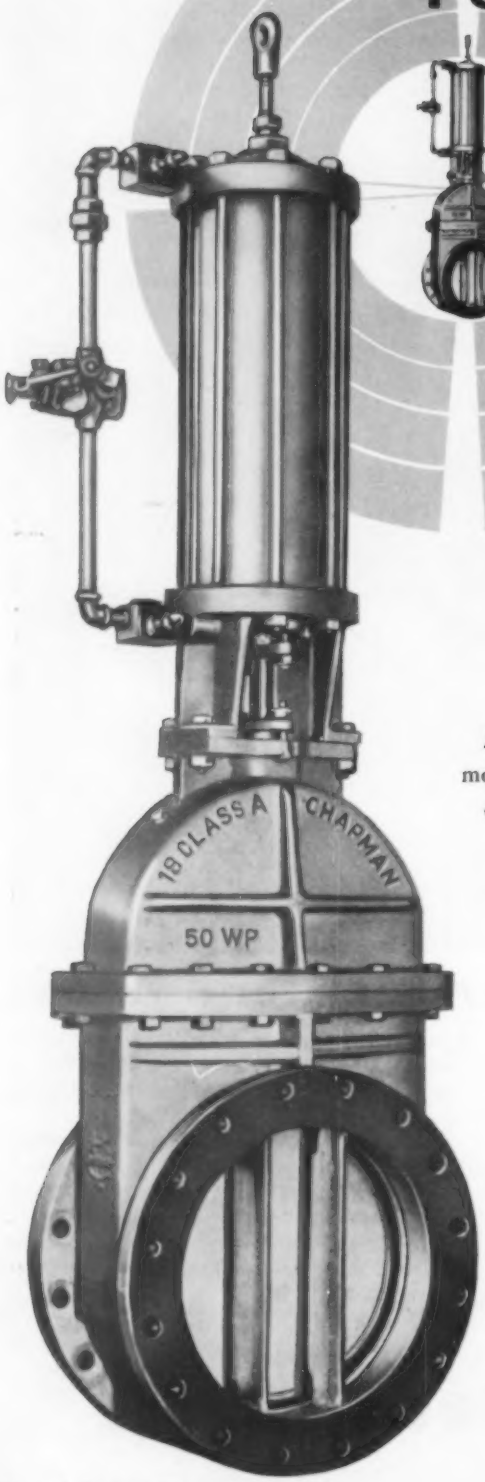
Contact our factory trained engineers at any of the 28 "U. S." District Sales Offices or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

For Top Performance IT'S On the Beam



Chapman's Beamed Waterway Gate Valve

Add it all up. In the partly open position, six to ten times more bearing contact surface than with any other double disc parallel seat or square bottom gate valve. Long wearing bronze bearing surfaces on beams and downstream discs. Smooth operation. Tight seats. Practically no leakage. Chapman craftsmanship throughout.

It all adds up to just one thing. For Filtration Plants, for Wash Water Valve Service, or other similar limited throttling conditions, your surest answer is Chapman's Beamed Waterway Gate Valve. For top performance . . . decades of good useful life with lowest maintenance costs . . . it's really on the beam.

In all standard sizes. Operation: by any desired method. Described in full in Chapman's Catalog No. 45. Write for your copy today.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

Superior DUAL-FUEL ENGINES CUT OPERATING COSTS

in New York sewage treatment plant

Six Model 80 Superior Dual-Fuel Engines, operating 92% of the time on sewage gas, run six 1125 KVA generators to provide the sole power source for all plant equipment at The Department of Public Works, Owl's Head Sewage Treatment Plant, New York City, having a capacity of 160 million gallons per day.

After a total of 78,000 hours running time, the New York maintenance crew completed the first overhaul of the six Superior engines. Practically no major part replacements were necessary! There was no noticeable wear on the cylinder liners, bearings or other vital parts! Since the engines were torn down, piston rings were replaced; but the old rings were still good enough to save for spares! Records show very low lube oil consumption and pilot fuel costs figure out to only 9 tenths of a mill per KWH. This Superior performance is cutting operating costs to a bare minimum at New York's Owl's Head Plant!

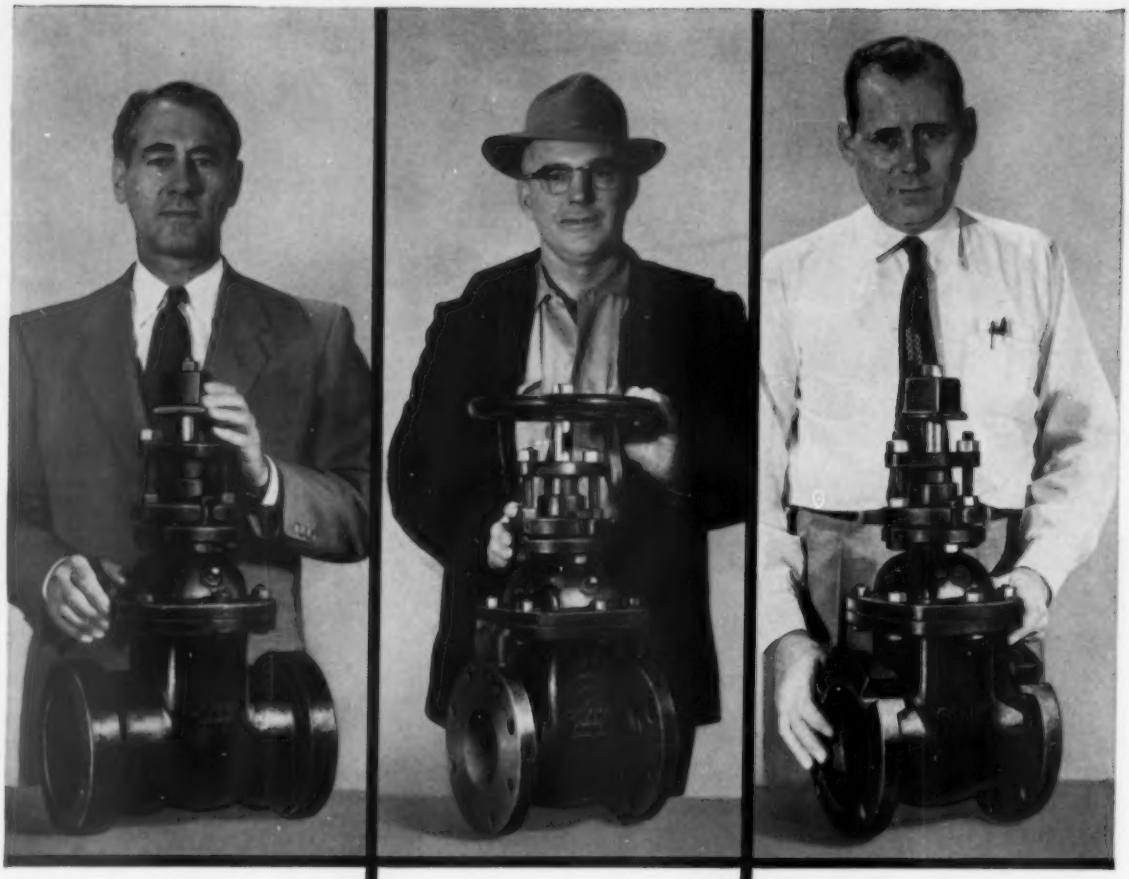
Similarly outstanding performance records are being established throughout the U.S.A., and most other parts of the world where Superior and Atlas Diesels are used for all kinds of power needs. For complete details on how Superior and Atlas power can cut operating costs for you, contact the nearest sales and service office listed below.

Superior ENGINES · ATLAS Imperial DIESEL ENGINES · White DIESEL

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY • ***Plant and General Offices: Springfield, Ohio***

SALES AND SERVICE POINTS: Gloucester, Mass. • Houston, Ft. Worth, Texas • San Diego, Oakland, Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Portland, Astoria, Oregon • Casper, Wyoming • Halifax, Nova Scotia • Vancouver, B.C. • Park Rapids, Minnesota • New York • Chicago • Seattle • New Orleans • St. Louis • Wichita, Kansas



"We use CRANE A.W.W.A. *hub end* valves in our lines."

"We need CRANE A.W.W.A. *flanged end* valves."

"We like CRANE A.W.W.A. *mechanical joint end* valves."

New CRANE A.W.W.A. Valves Available with the 3 Preferred End Connections

Whichever of the 3 is best for you—hub, flanged, or mechanical joint end connection—you can have added years of dependable, trouble-free service with new Crane A.W.W.A. valves. They're made with all 3 of these popular ends.

These new gate valves feature free-to-rotate discs that prevent concentrated wear on seating surfaces . . . simplified wedging action that assures positive seating . . . disc flange guides that hold the disc assembly in close alignment for maximum operating efficiency and minimum wear . . . and strict compliance with *all* A.W.W.A standards for gate valves for ordinary water works service.

Specifications Supplied on Request

New Crane A.W.W.A. valves come in all sizes from 2 to 12 in. Circular AD-2108 will give you complete technical data and help in your selection. Get a copy from your local Crane Representative, or write to address below. No obligation.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

This Booklet shows...

...how Transite Sewer Pipe saves in **4** important ways

Selecting the right pipe material for a new sewage system—or for additions to an existing one—is a problem of major importance to *all* concerned in influencing a choice. *And* it can be solved to *the complete satisfaction of both installer and user* with economies in each of these stages—(1) system design (2) installation (3) operation and (4) maintenance.

Engineers thinking in long-range terms of thoroughly proved sewer main performance . . . contractors interested in serving community needs at new lows in installed cost—both should know all about Transite® Pipe and the Ring-Tite® Coupling. Here is a new booklet that tells and shows how Transite Pipe reduces infiltration, keeps out roots; maintains high flow capacity; speeds installation; permits designing the system for savings. Send the coupon for it today.

Johns-Manville

TRANSITE SEWER PIPE

WITH THE RING-TITE COUPLING

Johns-Manville, Box 60, New York 16, N. Y.
Gentlemen—Please send me your new Transite Sewer Pipe Brochure, TR-165-A.

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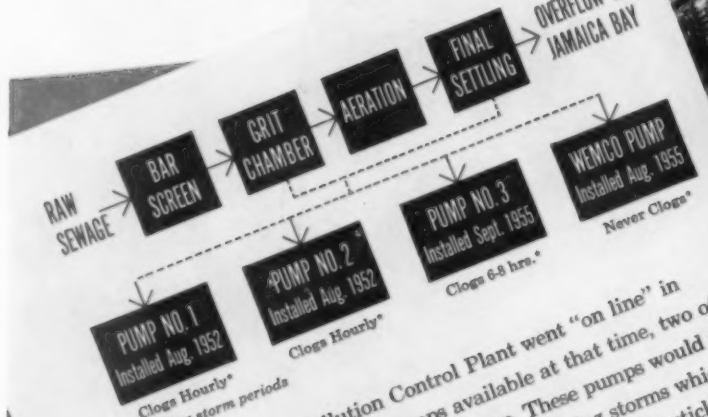
Street_____

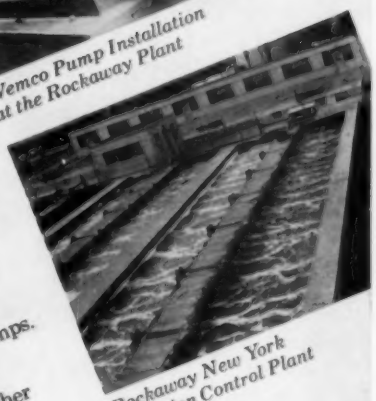
City_____

WEMCO *the sewage pump that never clogs* **PROVED IN COMPETITIVE SERVICE** *at Rockaway, New York*

Rockaway New York Pollution Control Plant



Wemco Pump Installation at the Rockaway Plant



Rockaway New York Pollution Control Plant

The Rockaway Pollution Control Plant went "on line" in August 1952 using four pumps available at that time, two of which remain in the flow sheet above. These pumps would plug on an average of once every two hours during storms which washed in comparatively large amounts of rags and sticks. During August 1955 a WEMCO Torque Flow Solids Pump was installed as a replacement of one of the four original pumps. **The WEMCO Pump has never clogged** and has operated through numerous clogging situations during which the other pumps continued to clog as described.

Case History No. 3

Los Angeles, Calif.
San Leandro, Calif.
Ogallala, Nebraska

Wemco's unique torque-flow design has been responsible for many outstanding "never clog" records. The principle is fully explained in available literature. It will save you thousands of dollars in operating costs. Write today for your copy.

WEMCO
WESTERN MACHINERY COMPANY

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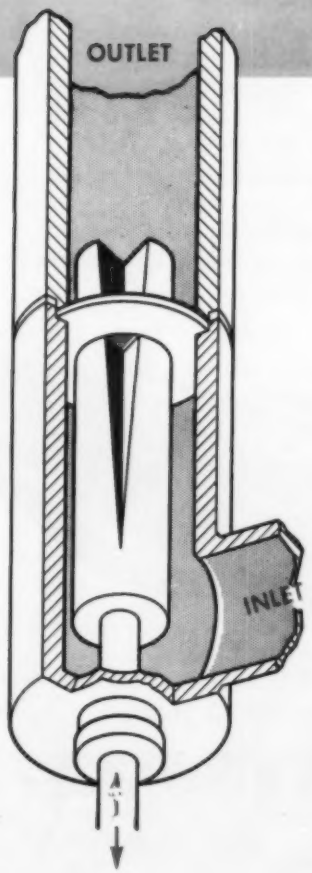
THE WALLACE & TIERNAN

V-NOTCH

variable-orifice

. . . a new concept for chlorinator control



The W&T V-notch Variable-Orifice is the heart of a new chlorinator control system. With the system, a constant differential vacuum is maintained across the V-notch Variable-Orifice and the flow of chlorine gas is adjusted by varying the area of the orifice.

The W&T V-notch Variable-Orifice has these features:

- Wide range adjustment of chlorine flow
- Excellent reproducibility of flow by a simple adjustment
- Same % accuracy over entire wide flow range

As can be seen in the diagram, the V-notch Variable-Orifice is formed by a cylindrical plug positioned inside a matched, circular ring. A V-shaped groove is machined along the length of the plug. The groove starts near one end of the plug and gradually enlarges to its maximum width and depth at the other end of the plug. The V-notch Orifice is formed at the intersection of the grooved plug and the matched ring. The orifice area is varied simply and positively by positioning the plug backward or forward inside the fixed ring.

The V-notch Variable-Orifice is just one design feature of the new W&T V-notch line of chlorinators. Get all the facts about the W&T V-notch chlorinators before you buy chlorination equipment.

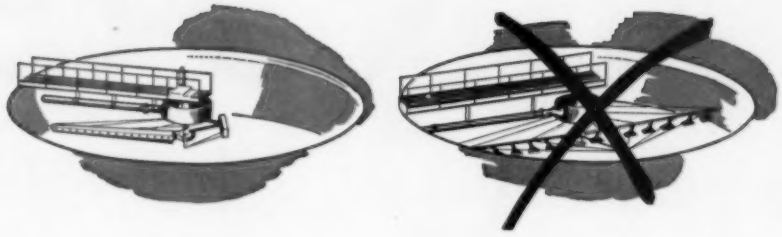
WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

S-107

Now, one header is better than two

REX Unitube Tow-Bro



In the new Rex Unitube Tow-Bro Sludge Remover, one header arm actually outperforms the two arms used in the previous Tow-Bro design. You retain the outstanding performance of Tow-Bro...gentle suction action—so efficient for positive removal of light flocculent sludges with minimum agitation, high solids concentration and fastest removal rates.

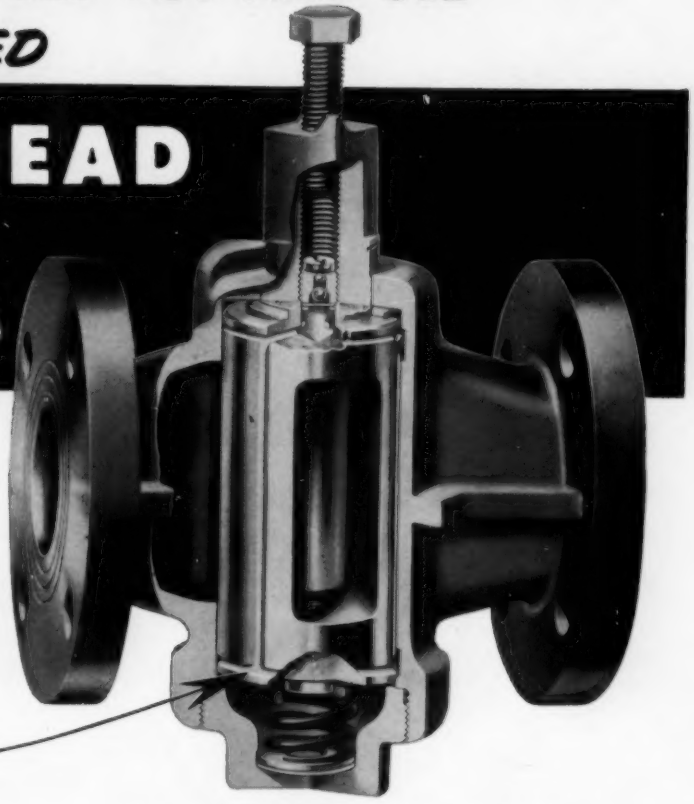
Through a complete redesign of the Tow-Bro header arm—changing the stepped round tube to a single tapered, peaked-roof header with a series of spaced orifices—Unitube Tow-Bro actually gives you better performance—at a substantially lower cost. The new design saves up to 20% in equipment cost compared to the previous two-arm designs.

If your plant handles light, "tricky" sludges such as activated sludge, Unitube Tow-Bro is your economical answer. It is ideal for any size plant, small, medium or large...round or rectangular tanks. For complete information, write for your copy of Bulletin No. 315-81. CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN

No. 5* of 12 REASONS WHY
YOU SHOULD BUY AND USE
LOW-PRICED
HOMESTEAD
Lubricated
PLUG VALVES



*SELF-FREEING PLUG PREVENTS STICKING

Homestead's exclusive completely controlled lubricant system positively prevents sticking by its instant, piston-like movement of the plug downward at the start of each lubrication. Spring and line pressure return it to stem-sealed position.

This is only **one reason why you should buy and use low-priced** HOMESTEAD LUBRICATED PLUG VALVES.

HERE ARE ALL TWELVE

1. Extra long valve life assured by very close tolerance between sealing surfaces.
2. Straight line fluid flow—streamlined ports—minimum resistance to flow—minimum pressure drop.
3. Triple head seal—two lubricant rings and reinforced Teflon stem seal prevent leakage.
4. Easy turning—plug floated on Teflon washer and reinforced Teflon ring.
5. Self-freeing plug prevents sticking.
6. Full-threaded screw prevents dirt being forced into lubricant system.
7. Quarter-turn fully opens or closes.
8. Reinforced Teflon stem seal—no cold flow—continuous, positive seal.
9. Seating surfaces protected in both open and closed positions.
10. High pressure lubricant system provides full lubricant seal around ports.
11. Leak-proof double ball and lubricant sealed check valve. No springs. No maintenance.
12. Two lubricants handle most services.

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HOMESTEAD
VALVE MANUFACTURING COMPANY
"Serving Since 1892"

P. O. Box 42 **Coraopolis, Pa.**

Without obligation, send Reference Book 39—Section 5 on HOMESTEAD LUBRICATED PLUG VALVES.

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COMPANY_____

ADDRESS_____

CITY_____ STATE_____

FOR BETTER RESULTS
WITH LESS TROUBLE
...PICK *ONE*
INSTEAD OF TWO

1½" or 2" Style 3 Meter matches performance of complicated compound . . . with less cost and fuss

For 1½" and 2" water service lines, the Trident Style 3 meter is simpler, costs less to buy and maintain, is every bit as accurate, and produces just as much revenue over a wide range of flows as any compound, including our own. Trident was *first* to give you an easy-to-set pressure adjustment. And since modern Style 3 parts fit older meters, there's never any obsolescence.

So why put up with the fuss and expense of two measuring units when one Style 3 will do the job? You'll find conclusive evidence in your own records . . . or ask your Neptune man.

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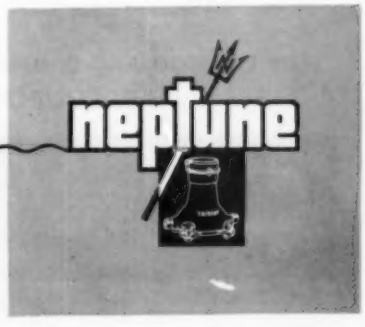
NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities.



WATER & SEWAGE WORKS

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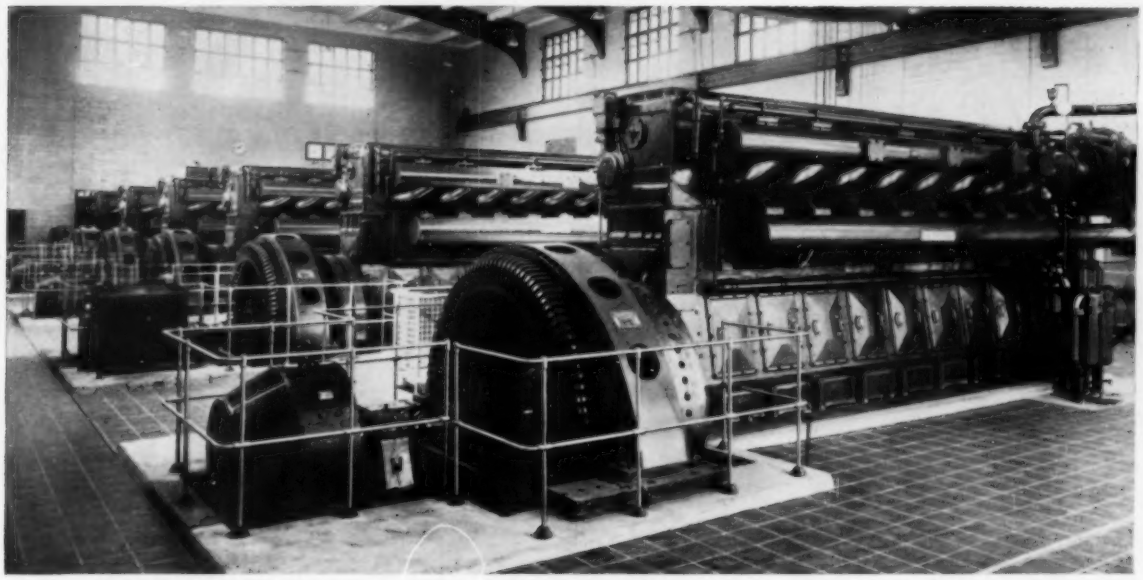


ENGINE BATTERY—Six "Superior", turbocharged, 1300 bhp, 327 rpm dual-fuel 8 cylinder diesels drive Westinghouse 1125 KVA generators as the sole power source of the Plant.

Dual-Fuel Engine Operating and Maintenance Experience

At New York City's Owls Head Sewage Treatment Plant and Pollution Control Project

THE OWLS HEAD Sewage Treatment Plant and Pollution Control Project, with a designed capacity ot 160 M. G. D. dry weather sewage flow, was designed for, and employs the high rate activated sludge process. It was designed by and constructed under the supervision of engineers of the New York City Department of Public Works. Frederick H. Zurmuhlen, P.E., R.A., is Commissioner of Public Works, and William A. O'Leary, is Director of the Division of Sewage Disposal, Dept. of Public Works.

NATHAN I. KASS

by NATHAN I. KASS and FORTUNATO H.A. LINO

Nathan Kass, P.E., is Chief of the Bureau of Sewage Disposal Operations, N. Y. City Dept. of Public Works.

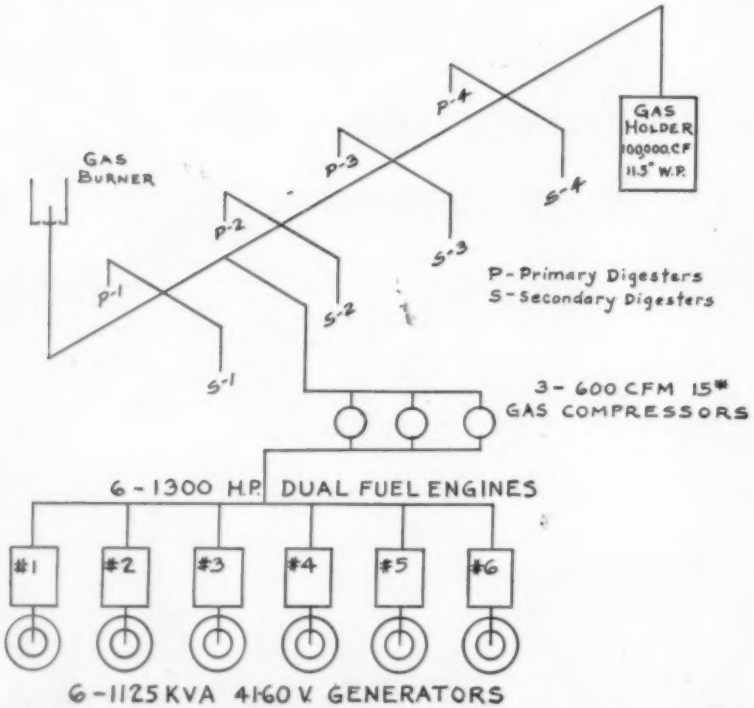
"Al" Lino is Superintendent of the efficient and well operated Owls Head Sewage Treatment Plant. This report evidences operating power economy as well.

F. H. A. LINO

OWLS HEAD 160 mgd sewage treatment plant employs the high-rate activated sludge process.

Note covered tanks, battery of two-stage digesters with gas holders. Loading at the dock is one of the million dollar sludge vessels for deep-sea disposal of the spent sludge.

Incorporated in the design is the plant's freedom from public utilities for operating power; no provisions for utility stand-by had been made nor contemplated for the operation of the plant equipment, all of which is electric motor driven. These motors range in size from 700 H.P. units used on the four centrifugal air blowers and on two of the main sewage pumps, down to the 1/2 H.P. units used on the sludge collectors.



SCHEMATIC sketch of gas system from digesters to gas storage, to gas pressure boosters, to engines driving generators

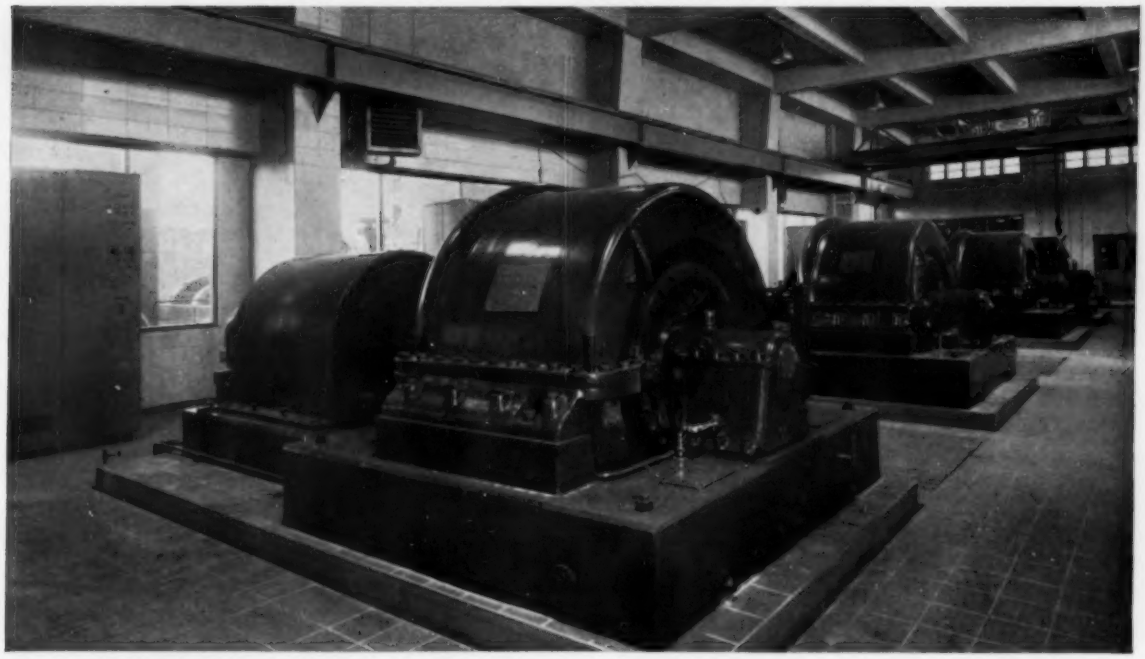
To meet the full load requirements of the plant, the following equipment was to be installed: six dual-fuel engines, each of 1300 B.H.P., direct connected to 1125 KVA, 4160 V, 900 KW (at 80% power factor) generators, with direct connected exciters.

In order that all the major engine maufacturers could compete for this installation, bids were accepted on two proposals: (1)-naturally aspirated engines and (2) supercharged engines.

Dual-fuel supercharged "Superior" engines were selected on a basis of a bid by their manufacturer, then the National Supply Company. The White Diesel Engine Division of the White Motor Company has since become the manufacturer of "Superior" Diesels. The six engines installed are 8 cylinder, 14-½ inch bore x 20 inch stroke.

The gradual assignment of the plant's operating personnel started November 1, 1951, about four months before treatment of sewage actually began. By then, the engine installation had been completed and the units had received considerable "no load" running time.

As soon as the operating personnel acquainted itself with the generating



AIR BLOWERS—battery of four Roots-Connersville turbo-compressors driven by 700 hp G.E. induction motors.

units, a series of actual load tests were commenced.

Early Difficulties

Difficulty was encountered with some of the alarm and protective devices. All but two of these troubles were quickly rectified. The exceptions took considerably more time due to the difficulty in localizing the faults and the work involved in making the necessary relay relocation.

The first trouble manifested itself in that the engine on test developed the defect of shutting down with no indication as to the cause.

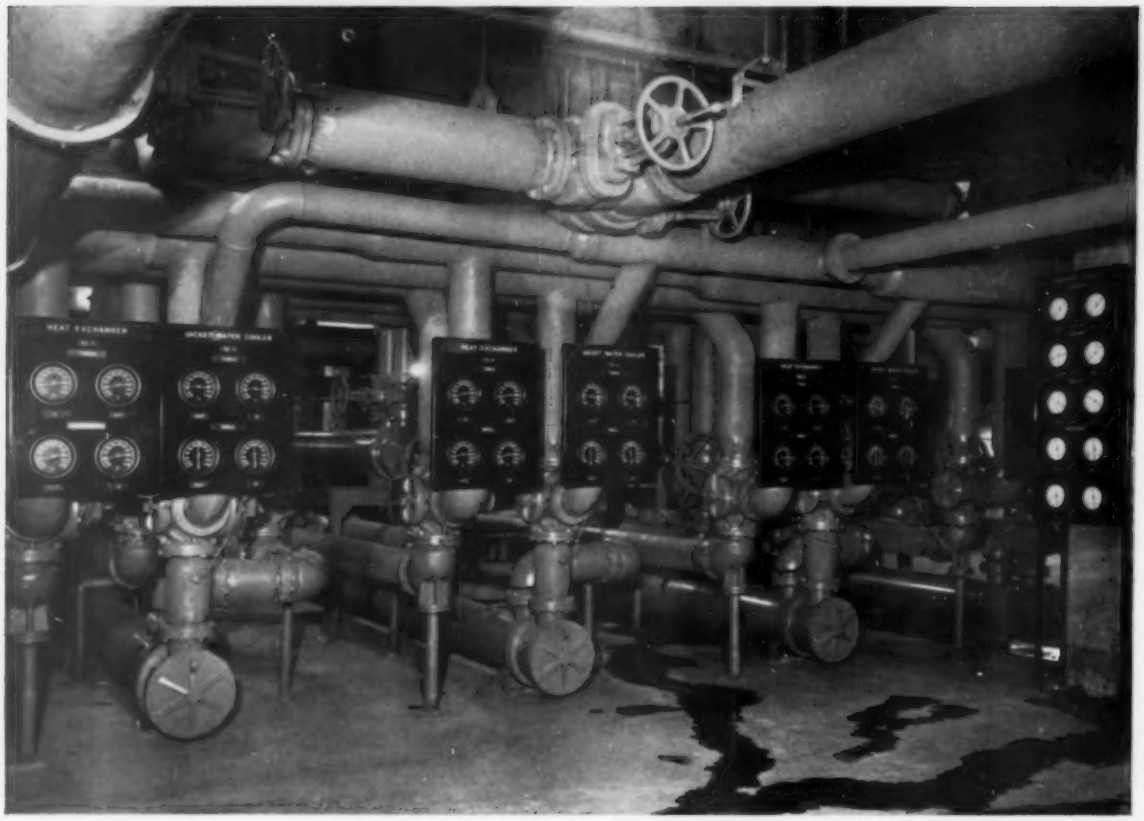
Each of the protective devices and relays were bench tested and were found to be in good operating condition. The control wiring was checked and found to be clear.

After numerous observations and tests, it was ascertained that the centrifugal overspeed relay on the engine was at fault.The manufacturer's representatives agreed and arranged testing of the relay in their laboratories, where the device could be instrument tested under simulated field conditions. It was found that the original washer was causing false operations of the device due to its resilient construction. These operations were of such short duration that the relay that would have indicated the operation of the overspeed device, could not be picked up sufficiently to "hold-in".

This situation was corrected by using a heavier and less resilient washer between flanges; and the relay was returned to the Owls Head Plant. Five other similar washers were included, with instructions that they be used as replacements for the original washers in the overspeed relays of the other five engines: This was done.

A re-occurrence of the defect mentioned took place about three

MAIN SWITCHBOARD built by Trumbull Electric Co. from General Electric equipment throughout.



HEAT EXCHANGERS—battery of four Ross jacket water coolers and heat recovery exchangers. The gauges are Aschcroft.

years later. Renewing of the washers eliminated the trouble.

It was found, on close inspection of the removed washers, that the pin holes in them had become only slightly elongated, yet this wear was enough to cause a "backlash" operation of the device.

The other difficulty of note was the failure of some of the engine-mounted relays to hold-in while the engine was in operation. The construction of the relays, both electrically and mechanically, was such that the normal engine vibration would cause the contacts to arc and finally open, thus causing false engine alarms and shut-downs. Relocation off the engine and better constructed relays overcame this source of trouble.

Maintenance Policy Established Early

After several conferences, before the plant was placed in operation, a policy regarding the maintenance of the engines was established.

One of the principal points agreed upon was that only small repairs, that could not possibly change any engine adjustments, were to be made by the operating force. All other mechanical work required for the proper operation and maintenance of the engines were to be performed by mechanics working out of the engine maintenance group, serving all plants in the Bureau of Sewage Disposal Operation.

Some of the other items agreed upon, were:

(a)—Oil centrifuging (when on batch process) was to be done on a 500 running hour schedule.

(b)—Oil filter replacements on a 2000 hour basis.

(c)—Valve overhaul every 4000 hours.

(d)—Complete engine inspection on a 12,000 running hour schedule.

(e)—Crankcase inspection on a 2000 running hour basis.

This understanding, between the operating staff and the engine maintenance group as to their respective functions has returned dividends in reduced enforced engine shutdowns and in lowered maintenance costs.

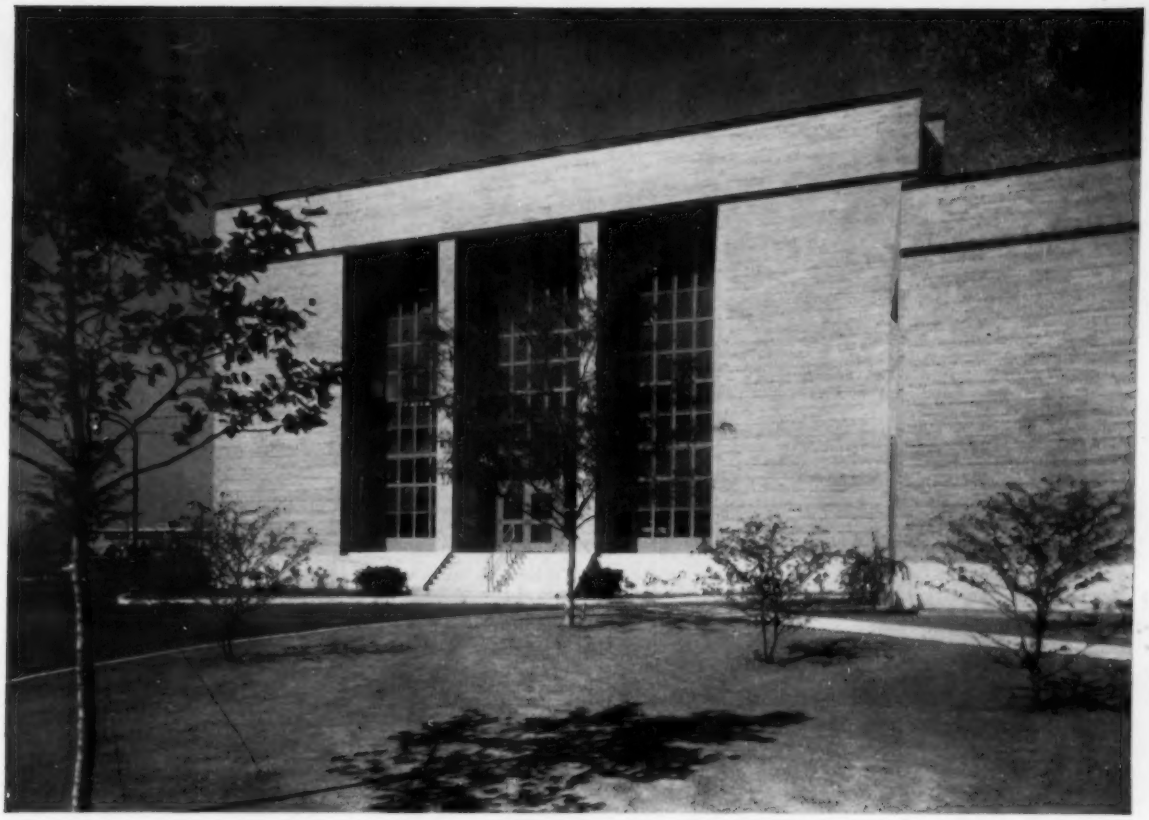
Treatment of sewage was started on February 19, 1952 with the engines operating as full diesels. By April 15th, digester gas in sufficient quantity and of satisfactory quality was available, and adjustment for dual-fuel operation of the engines was begun. Final adjustments were completed October, 1952.

Fuel Oil Costs

During the initial period, namely, from February 19 to April 15, 1,394,000 KWH were generated at a fuel oil cost of $0.0077 per KWH. From April 15 to December 31, 1952 10,988,000 KWH were generated at a fuel cost of $0.0018 per KWH.

From January 1, 1953 to December 31, 1955, a three year period with full dual-fuel operations, the cost of fuel oil used for all engine purposes has average only $0.0009 per KWH. In that period, the plant generated a total of 46,100,000 or approximately 42,000 KWH per day.

The fuel oil consumption prior to the dual-fuel operation of the engine: had reached 3,000 gallons of No.2 diesel oil per day. Since stabilized dual-fuel operation of the engines was achieved, the daily consumption of fuel oil for the three year period has averaged approximately 380 gallons per day. This figure includes pilot fuel used during warm-up periods, engine testing and "run-ins". Also included in the 380 gallons is fuel oil used when enforced full diesel operation of the engines was made necessary due to gas compressor failures and to reduced gas supply. The



POWER, pump and bower building entrance at Owls Head Plant, Brooklyn, N. Y.

gas compressors are used as boosters, in order to increase the digester gas header pressure from 11-½ inches of water to 15 psi at the engine.

The reduction in fuel oil consumption during the three year period from January 1, 1953 to December 31, 1955 because of dual-fuel operation as compared with full diesel operation represents an annual saving of approximately $105,000, at fuel oil costs, that varied from 10.1 cents to 10.5 cents per gallon.

One of the requirements of the engine contract was that the engines go from dual-fuel to full diesel operation and still maintain parallel operation, this with control changes in fuel proportions. From the numerous gas compressor failures, with accompanying sudden reduction in gas pressure, it was found that the quick manual dropping of load helped to keep the generators on line while the engines, through the governors, adjusted themselves to the change in fuel proportions.

Gas Production Adequate

From April 16, 1952, when the use of gas began, to December 31, 1955, approximately 930,000,000 cubic feet of gas, with a B.T.U. value averaging about 650 per cubic foot, have been used in the engines. Gas production has normally averaged far in excess of the quantities needed to operate the engines and to fuel the boilers for space and digester heating. This average has been estimated in excess of 900,000 cubic feet per day. There have been times, such as following heavy rainstorms, when gas production has not fully met the demand.

For the present dry weather flow, averaging 85 M.G.D., three generating units are operated in parallel for the period 8 A.M. to midnight, after which two unit operation is practiced. The units are normally operated at about 80% of capacity. There have been times when the units on the line have been loaded to about 110% of capacity for the short time it takes to bring in another unit.

During rainstorms, an additonal unit is necessary to take care of the added pumping load.

Load demands vary from 2250 K.W. present normal dry weather full load, down to 1200 K.W. for the normal after midnight load. During rainstorms, the demand has peaked to about 3,000 K.W.

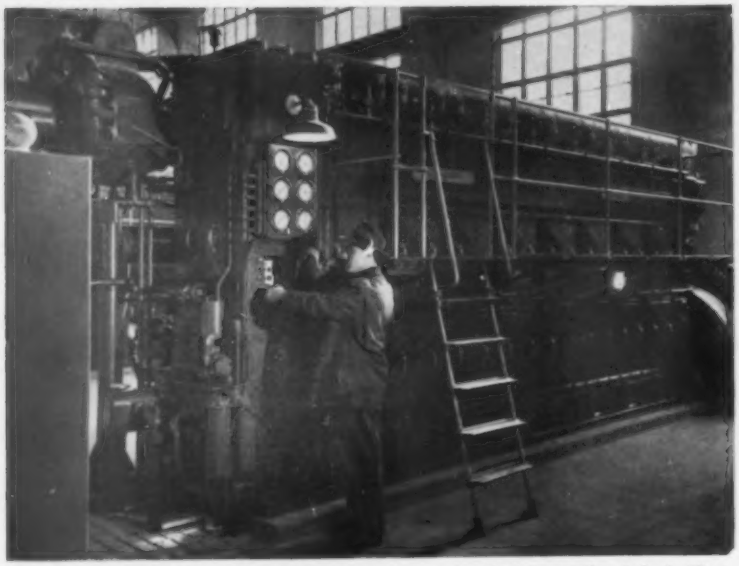
No difficulty was experienced in parallel operation nor in the maintenance of the 60 cycle designed frequency even when as many as five generating units were on the bus simultaneously during test runs.

Meaning of Proper Maintenance

Successful parallel operation of dual-fuel engines using minimum pilot oil is largely dependent on proper engine maintenance. Sloppy tappet clearances, incorrect fuel proportioning and incorrectly adjusted fuel nozzles will lead to very heavy load exchanges between generators.

One of the problems encountered during substantial dual-fuel operation has been carbonization of the fuel nozzles. This carbonization becomes evident when the resultant poor ignition causes erratic firing in the cylinder affected. It was found that operating the engines as full diesels for about four hours, on a 500 running hour basis, under normal load helps overcome this condition.

Since the plant went into operation and up to December 31, 1955, the engines have been on the line for a combined total of over 91,000 hours.



STARTING one of the "Superior" diesels is accomplished on diesel fuel. Then, upper push button throws engine over to automatic dual-fuel (gas & diesel fuel) operation.

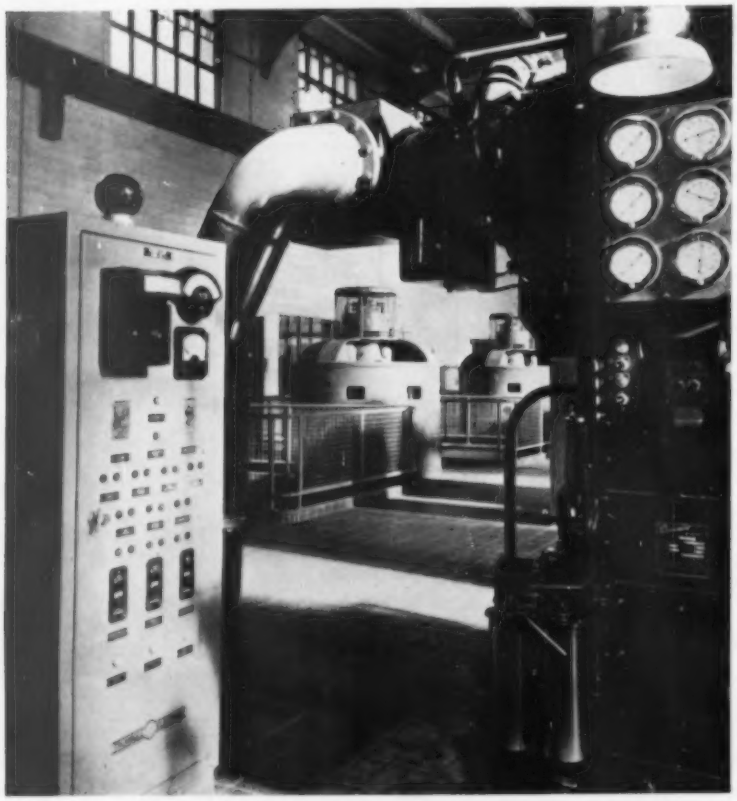
The enforced shutdowns during that period have been negligible.

In February, 1956, the fourth overhaul of the valves was started. All that has been found needed was the refacing and lapping-in of the valves and seats. No replacements of these parts were found necessary as yet.

In the scheduled inspection after 12,000 hours of operation every wear point in the engines was checked. Wear was found to be far less than had been expected.

The piston rings were renewed, in order to forestall possible excessive oil consumption before the next scheduled 12,000 hour inspection. The rings removed were found to be in such good condition that they are being carried in stock as spares. It was necessary to replace only four connecting rod bearings because of babbit separation.

Credit for the trouble-free operation of the engines is due to the operating and engine maintenance forces for their sincere efforts in the strict adherence to their respective maintenance schedules.



AUTOMATIC control cubicle (one to each engine) has signal lights for all normal, and alarm signals for all abnormal conditions.

Economy of Power from Dual-Fuel Engines and Generators

The economy of power generation at the Owls Head Plant, using dual-fuel engines, can be best illustrated by considering the accompanying cost tabulations.

The present personnel could operate and maintain generating equipment capable of producing about 70% more power than the present daily average, of 42,000 KWH. However, in computing the personnel cost, the figure used was 42,000 KWH. On this basis, the personnel cost is $0.0042 per KWH.

The design and construction of the main building, part of which is used to house the generating units, is in keeping with the highly regarded residential section in which the plant is located. $1,064,900 of the total cost of this structure and $815,900 of the cost of the generating units, with their auxiliaries and the gas holder, have been charged to power generation.

With amortization of the structure on a 40 year basis and that of the equipment on a 25 year basis, using the straight line depreciation method at 3% interest, the amount chargeable to power generation for interest and amortization is about $88,400 per year or about $7400 per month.

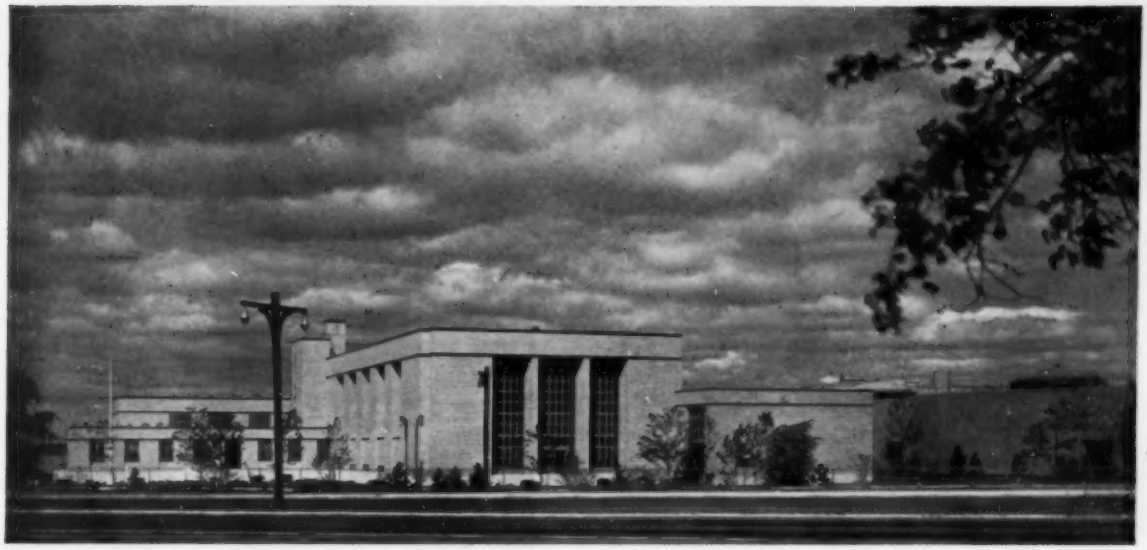
In the design of the Owls Head plant it was anticipated that the ultimate average daily sewage flow, which would be gradually increasing during the useful life of the power generating equipment, will approximate twice the present flow. On this basis, the average monthly power consumption during this period will be—

$$\frac{(42{,}000 \text{ KWH/day} + (42{,}000 \times 2)) \, 30}{2}$$

$$= 1{,}890{,}000 \text{ KWH/month}$$

$$\$7400/1{,}890{,}000 \text{ KWH} = \$0.0039 \text{KWH}$$

Maintaining that part of structure



ATTRACTIVENESS and odor control was emphasized in Owls Head design and operation because of its location alongside the important Brooklyn Belt Parkway.

housing the engines is $5,000 per annum or $417 per month: and, $417/1,890,000 = $0.0002 KWH.

The cost of replacement parts used and engine repairs performed by contractors, for the period from January 1, 1953 to December 31, 1955 amounted to $12,650. This amount is chargeable to actual power generated.

$12,650/36 Mo. = $350 per month.

$350/1,260,000 = $0.0003 per K.W.H.

During this period lubricating oil cost was $0.0001 per K.W.H. on the basis of 42 cts. per gallon.

Recapitulation

Total cost of power generation per K.W.H. at the Owls Head plant during the three years of operation reported is as follows:

Operating personnel	$0.0042
Structure and equipment	$0.0039
Maintenance of building	$0.0002
Engine parts and repair	$0.0003
Diesel oil	$0.0009
Lubricating oil	$0.0001
Total per K.W.H.	$0.00096

Comparing Cost of Purchased Power

Were utility power used at this plant, the cost to the City would be $0.0137 per K.W.H. This is based on the following prevailing utility rates and on an average monthly consumption of 1,260,000 KWH and a 2700 KW demand.

Utility Rates Per Month

$0.016 per K.W.H. for the first 100,000 K.W.H.	$ 1,600.00
$0.009 per K.W.H. all over first 100,000 K.W.H.	$10,440.00
$1.76 per K.W. demand for the first 500 K.W.	880.00
$1.40 per K.W. demand for all over first 500 K.W.	3,080.00
$0.001 per K.W.H. coal charge	1,260.00
	$17,260.00

Average monthly charges:

$17,260/1,260,000—$0.0137 per K.W.H.

The difference between the cost of power, if purchased, over that of gas generated power at this plant is $0.0041 per K.W.H. This difference represents an average saving of $61,667 annually, representing an overall saving of $185,000 for the three years, during which by-product power has been developed with dual-fuel engines. This amount will increase, of course, with the increase of sewage flow.

It must be noted also that during the heating season, there is a saving of about $36.00 per day due to the utilization of heat extracted from the engine jacket water and from the exhaust water heat boilers. These two heat sources provide about 60% of the winter requirements for building and digester heating.

The cost data shows that the selection by the department engineers of dual-fuel generating units for power production, as against purchasing utility power at the Owls Head plant, has been well justified. It is also apparent that in installations similar to Owls Head plant, where digester gas can be produced in sufficient quantities, the use of dual-fuel generating units is both feasible and economical.

PERSONNEL

(Total cost per KWH = $0.0042)

	A	B	C	D	E
Watch Engineer	$22.57	3	7	60%	$284.38
Watch Oiler	$17.72	3	7	100%	$372.12
Utility Man	$13.50	3	7	50%	$141.75
Machinist	$20.35	1	5	100%	$101.75
Machinist Helper	$17.35	1	5	100%	$ 86.75
					$986.75
Supervision, Clerical				15%	$148.00
City's Share of Pension				10%	$113.47
Total per Week					$1248.22

A—Salary rate per diem
B—Number of watches per day
C—Number of days worked per week
D—Percent chargeable to power generation
E—Totals

STORAGE and transportation of hydrofluosilicic acid is in rubber-lined tanks

Hydrofluosilicic Acid For Water Fluoridation

by C. E. MEGINNIS
Applications Engineer
Davison Chemical Co.
Division of W. R. Grace & Co.
Baltimore, Md.

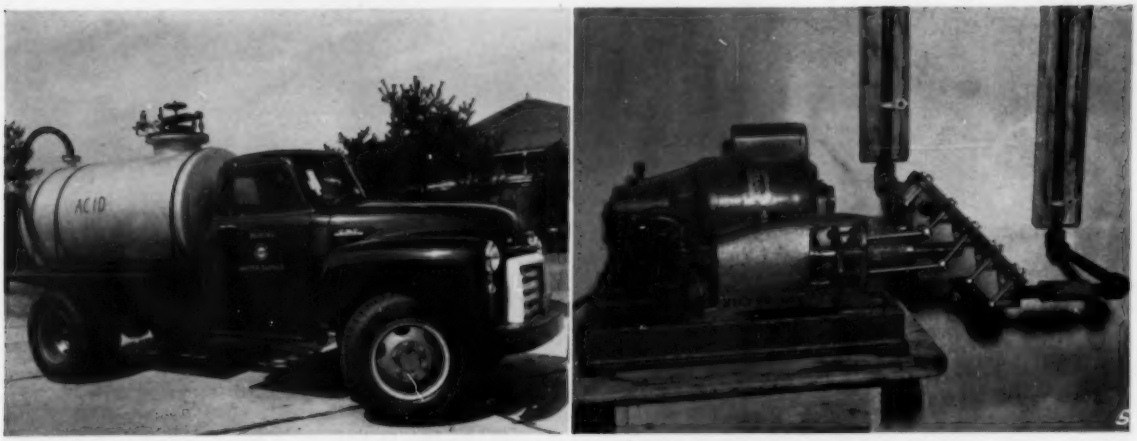
THE GROWTH OF WATER FLUORIDATION has focused attention on the relative merits for this purpose of the various fluoride compounds. Recently, the trend has been definitely toward choice of hydrofluosilicic acid. Not only the large installations for fluoridation, but also goodly proportion of the smaller ones have been engineered for the acid. Evidently, this is the form which most satisfactorily meets the engineer's various criteria of convenience, cost, safety and effectiveness.

In view of the trend noted, it should be of interest to consider something of the source materials and chemical derivation of hydrofluosilicic acid, as well as its characteristics for water treatment.

Source of Fluosilicic Acid

Fluosilicic acid has customarily been derived from processing of superphosphate, which is, of course, a basic inorganic fertilizer. In view of the rapidly rising production and use of the acid from this source, it is now more accurate to call it a co-product than a by-product. The raw materials for superphosphate production are sulfuric acid and phosphate rock. The latter occurs naturally in many areas throughout the world; in the United States principally in Florida, Tennessee and Idaho. The most significant rock deposits in America are in Florida and contain 30 to 35 per cent phosphorous, as phosphorous pentoxide (P_2O_5), and 3.5 per cent fluorine (F). After the phosphate rock is mined, it must be ground to substantially pass a 100-mesh screen to speed up its reaction with a 72 per cent concentration sulfuric acid. After acidulation, the mix is held for several weeks to allow for completion of the chemical reaction and the fixing of hydration water. During acidulation and curing, about one-half of the fluorine in the rock is converted to silicon tetrafluoride gas and recovered as weak fluosilicic acid by washing the gas with water.

The acid recovery ratio is low, averaging 10 pounds of 100 per cent hydrofluosilic acid (H_2SiF_6) per ton of superphosphate produced. But, since the production of superphosphate is estimated to be somewhat in excess of 10,000,000 tons each year, it would be possible to make available more than 50,000 tons of 100 per cent hydrofluosilicic acid. To indicate the magnitude of the potential supply, it suffices to note that Chicago will need approximately 2,000 tons per year of 100 per cent acid, or just 4 per cent of what can be made available.

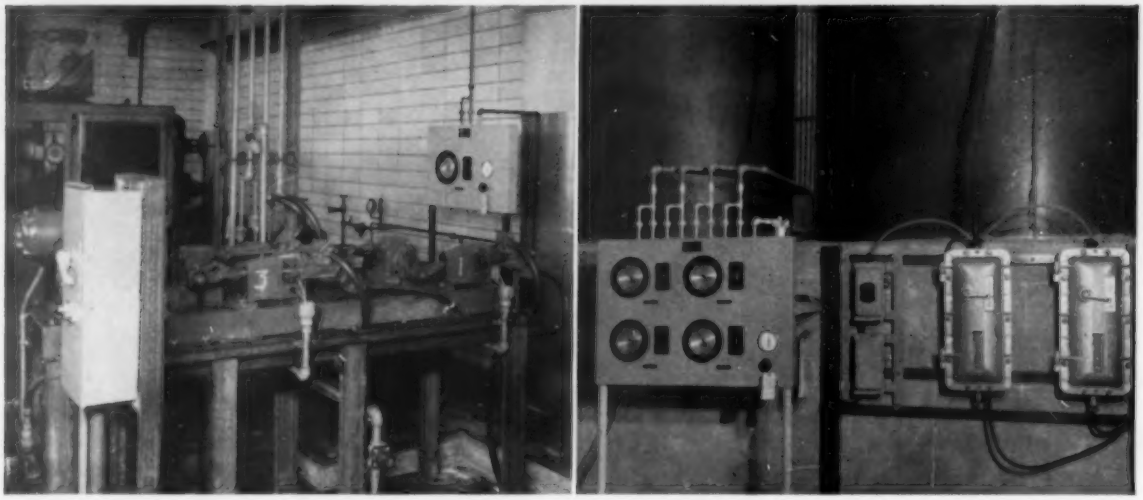


RUBBER-lined tank truck (left) and solution feeder (right) constitute only mechanical equipment for fluoridation of water by use of fluosilicic acid

Once the weak fluosilicic acid has been recovered, it must either be concentrated to a marketable level of at least 22 per cent H_2SiF_6 or converted to a desirable commodity such as the insoluble or soluble salts. The conversion to insoluble salts, sodium and potassium, is readily accomplished by adding the proper amount of sodium or potassium chloride. The insoluble sodium or potassium silicofluoride simply precipitates out of solution and is classified and dried. Soluble salts, ammonium, magnesium and zinc, are considerably more difficult to manufacture because there is an evaporation step which gives rise to a multitude of production problems, one of the worst of which is equipment corrosion. The concentration of the acid is a relatively new technique and requires special equipment and know-how.

Prior to the establishment of fluoridation procedures by the city of Baltimore*, based on the use of hydrofluosilicic acid, we at Davison found ourselves in a unique position. Although we were the only manufacturer of a complete line of silicofluorides (salts

UNLOADING tank-car of hydrofluosilicic acid to storage tanks—Chicago's Southside Filter Plant.



METERING PUMPS (Milton Roy) delivering correct dosage of fluosilicic acid to water and (right) storage tank elevation gauges and chemical pump controls—Chicago's Southside Filter Plant.

as well as the acid) we had recommended and sold only sodium silicofluoride for fluoridation purposes. Nevertheless, we were convinced, through both a rigid analysis of the controlling factors and typical reactions from municipal water people, that the acid approach would be superior to the dry feed method. Therefore, we worked closely with the City of Baltimore (the home of the company) to help promote the cause of acid fluoridation. The outcome is a matter of record: Baltimore's experience was eminently successful. Then followed Philadelphia, St. Louis and, more recently, Chicago.

Controlling Factors in Selecting Fluorine Compounds for Water

Let us treat for a moment the prime factors involved in selecting a material for water fluoridation. There are a number of fluorine compounds available: sodium fluoride, hydrofluoric acid, sodium silicofluoride, ammonium silicofluoride and hydrofluosilicic acid. The primary questions raised concerning them refer to dependable availability and price stability; economy; flexibility in use; handling problems, and safety. So far as availability and price stability are concerned, the astonishing amount of acid potential in this country has already been mentioned. Furthermore, the production of fluosilicic acid has been stressed, so it is now considerably more than a secondary product. A third factor is the sparcity of industrial hydrofluosilicic acid application, while industry strongly competes in the case of the other compound which can be used for water fluoridation.

From the standpoint of product cost, sodium silicofluoride is the only chemical in the group which is less expensive (about 7 per cent) than fluosilicic acid. However, equipment, installation, maintenance and labor costs are so much less when the acid is used that there is little true competition.

As to flexibility in use, the acid may be applied irrespective of plant capacity. Because of its unlimited solubility, the smallest of plants can use it successfully, whereas salt solubility would present a definite limitation. As to handling problems and safety, fluosilicic acid is a transparent, straw colored, corrosive but essentially non-fuming liquid. Ordinary precautions, such as the use of rubber gloves, safety glasses and protective clothing, should be practiced when working with the acid. However, it is unlikely that a worker will have any occasion to come into contact with the material.

In large installations, tank cars or tank trucks of acid will be unloaded, either with air pressure or by pumps, into rubber-lined steel tanks which are vented to the atmosphere. An accurate proportioning pump will feed the acid direct from the storage tank into the filtered water. There are several types of construction materials suitable for corrosive resistant equipment which can be utilized by a water utility or the manufacturers of pumps, valves, pipes and tanks.

For small communities, the standard rubber or polyethylene-lined shipping drum may be used as the storage tank. The acid can be withdrawn by placing a Saran or rubber hose in the drum and pumping it out with a positive displacement metering pump.

Use of the liquid fluosilicic acid eliminates the expense of dry feed equipment, the high cost of labor in handling, the inherent difficulties of powder feeding, and the hazards of toxic dust.

Based on the considerations of availability and price stability, economy, flexibility in use, handling and safety, hydrofluosilicic acid appears to be the overall first choice for water fluoridation.

* "How Baltimore Fluoridates." W.&S.W., Nov. 1954.

James H. Brace Passes

Founder and Officer of Engineering Firm

James H. Brace, president of the Fraser-Brace Engineering Co., of Montreal, Canada, and vice-president of Fraser-Brace & Co., engineering firm of New York City, died April 10 at Westmount, Quebec. He was 85 years old.

Mr. Brace graduated from the University of Wisconsin in 1892 with a civil engineering degree. For the next ten years he worked on various hydroelectric and water works projects in the Great Lakes region.

In 1903 he went to New York City as assistant consulting engineer on construction of the Pennsylvania Railroad tunnels. With Charles E. Fraser, superintendent of this construction project, he formed the Fraser-Brace Engineering Co. in 1909.

Automation in Water & Sewage Works*

Its Present and Future

by B. L. SOSCIA and R. W. LINDSEY

Messrs. Soscia and Lindsey are associated with B-I-F Industries, Inc. Mr. Soscia is a Development Engineer in Providence R. I. and Mr. Lindsey an Engineer in the Kansas City, Mo. office of the company. In this article they comment on a topic of growing interest.

AUTOMATION—A coined word which denotes "automatic operation." It is not new; the first automatic plant was a grain processing mill in Philadelphia in 1784 where grain was unloaded from a boat or wagon and processed to finished flour without human aid. Automation is not something for tomorrow, it is here today.

For persons working in the field of sanitary engineering these questions may arise: What is it? What are today's applications? How soon will other applications be available? What can it bring in the future? What will it mean to workers in the field? In this article, the authors answer those questions with predictions of the future and statements of facts as to the present.

What is Automation

Mechanized equipment control dates back five centuries, when sails were placed on windmills to keep them facing into the wind. Control of start-stop operations of modern power equipment began with valves on steam engines and switches on electric motors. Semi-automatic control became a reality when the operation of one device was controlled or paced by the operations of another device. Automatic operation or automation added one new factor, the principle of "feedback." Modern automatic operations have adapted the principle of feedback to the many modern means of transmitting information.

M. H. Aronson, Editor of *Instruments and Automation* has defined automation as "the substitution of mechanical, hydraulic, pneumatic, electric and electronic devices for human organs of decision and effort." In short, automation is automatic control initiated or monitored by a feedback signal. This principle of feedback means simply that the result of some operation is sensed or measured and the magnitude of that measurement is returned (fed back) to control the operation so that the result will be maintained within definite and desired limits.

Plant of the Future

Applications of semi-automatic and automatic control have appeared in water and sewage works for a number of years, but what is the future of automation in the field of sanitary engineering? Some comparison with other fields may give the clue. Both chemical processing and petroleum refining have found wide applications of automation. Both involve unit processes of operation. Water and waste-water treatment also involve unit operations (pumping, coagulation, sedimentation, filtration, aeration, chlorination, etc.) Therefore, it may be expected that automatic operation of water and sewage plants is both feasible and probable.

The writers asked M. E. Rogers, Manager, Engineering Projects, of Builders-Providence, Inc. and a former water works superintendent, to suggest the "dream water plant" of the future. Mr. Rogers wrote: "It is probable that the water plant operator of the future will not see the filter he backwashes except perhaps by closed circuit television. There are three current trends which will lead to this situation: (1) to eliminate all unnecessary construction in order to save on initial cost; (2) to cut settling time to 20 or 30 minutes, at the most; and (3) to make full use of automatic controls.

"The future laboratory will be equipped with an automatic analyzer where samples of both raw and finished water will be continuously analyzed and the information, along with flow data, will be fed into a computer mechanism which, in turn, will ad-

*A paper presented at the 6th Annual Conference on Sanitary Engineering of the University of Kansas, Lawrence, Kan., Jan. 4, 1956. Released for publication in Water & Sewage Works.

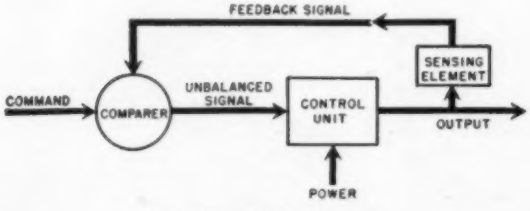


Fig. 1—SINGLE control loop

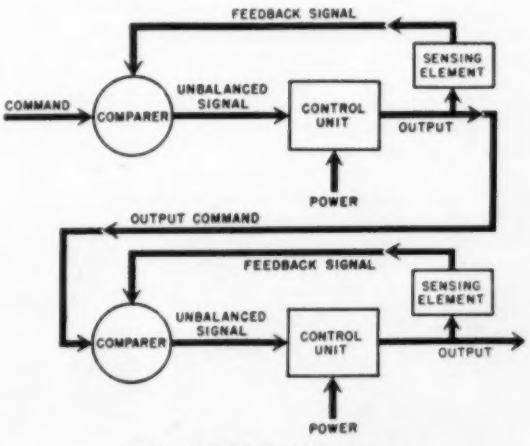


Fig. 2—CASCADE control loops

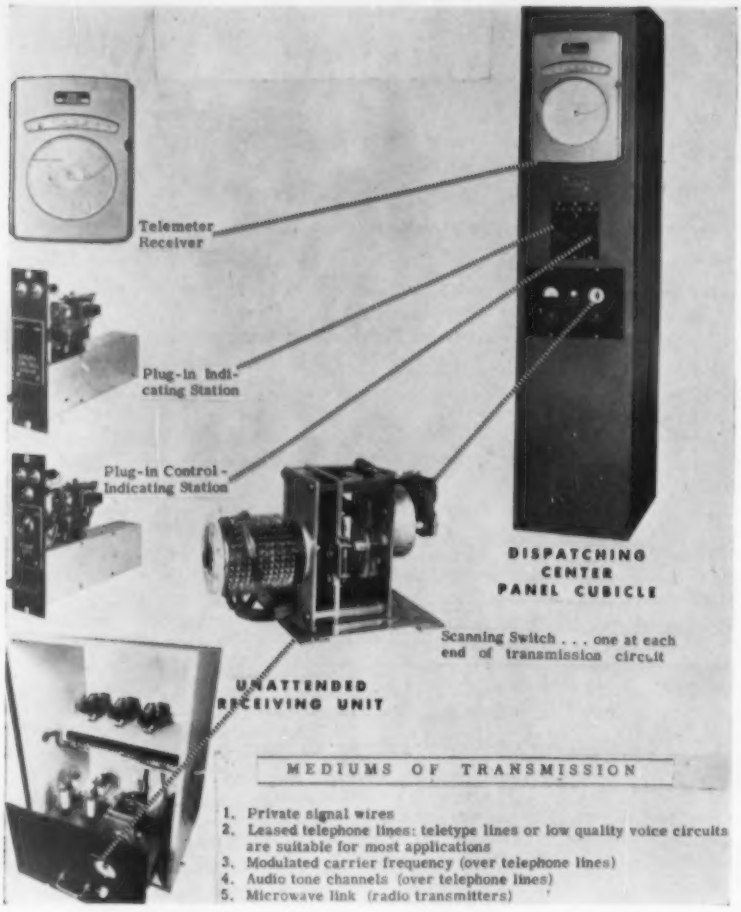

Telemeter Receiver
Plug-in Indicating Station
Plug-in Control-Indicating Station
DISPATCHING CENTER PANEL CUBICLE
Scanning Switch . . . one at each end of transmission circuit
UNATTENDED RECEIVING UNIT
MEDIUMS OF TRANSMISSION
1. Private signal wires
2. Leased telephone lines: teletype lines or low quality voice circuits are suitable for most applications
3. Modulated carrier frequency (over telephone lines)
4. Audio tone channels (over telephone lines)
5. Microwave link (radio transmitters)

Fig. 3—TRANSMISSION system—Scanning switch sequencing

just the chemical feeders to provide a predetermined minimum residual amount of turbidity, hardness, and taste and odor as well as the proper amount of chlorine for disinfection. On hard waters, a portion of the water will be passed through a demineralizer operating along electro-osmotic principles and recombined with a second portion which has merely been clarified to secure a predetermined final product containing just the right amount of the chemicals desired in solution.

"Wherever possible and particularly in larger plants, chemicals will be handled in solution or suspension to eliminate dust and save storage space. Solutions can be pumped to point of application and the need for high chemical head houses will be eliminated. Filters will be backwashed automatically, initiation being on the basis of maximum loss of head and termination of the washing period on the basis of turbidity in the waste water. Rate of backwashing will be controlled by sand size and expansion.

"Safeguards will be provided all along the treatment path to detect and prevent errors in operation. Closed circuit television may be used. Operating controls will be centralized in the chemical laboratory where a complete instantaneous picture of operation will be recorded on a continuous strip chart. Operator's duties will consist of checking calibration of various devices, renewing standard reagents in analyzing equipment, ordering chemical supplies, preparing statistical reports and supervising maintenance. The operator of the future will be a process supervisor who will be a trained engineer with a complete background in sanitary engineering plus knowledge of electronics and automatic operation.

"Except in emergencies, no one will adjust a valve to regulate rate of through-put, or start-stop of pumps. Flow through the plant to the consumer will be fully automatic at pressures and rates required by the conditions of demand on the distribution system. It is possible that the electron microscope will continually scan the final effluent and with a television feedback will control disinfection or sound an alarm to the community if the disinfection process fails."

The writers also asked Walter H. Brown, Project Engineer of Builders-Providence, Inc. and a former sewage works superintendent, for his ideas on the sewage works of the future. Mr. Brown wrote: "In the future waste treatment plant processes will be controlled automatically thereby requiring only trained supervisors and maintenance technicians. Sewage will be delivered to the plant by means of automatically controlled lift stations where pumps will operate in accord with flow requirements; will regularly rotate to distribute wear; and will cut out of service when partially clogged, with a warning signal to the central station to dispatch maintenance men for cleaning operations.

"For primary treatment, automatically cleaned trash racks and comminutors will precede grease removal units and primary settling tanks. Grease will be skimmed off and sludge removed in accord with the load or accumulation of each in their respective tanks. Both sludge and grease will be concentrated, seeded with special organisms and enzymes to produce chemicals or gases of commercial value, and pumped to digestion tanks which will operate at automatically controlled temperatures with the digestion process controlled by the end product produced. Sludge from these tanks will be washed, filtered and dried for soil conditioning use and the amount of washing, amount of chemicals for dewatering, vacuum filtration and heat drying will be controlled according to the sludge load which in turn will be governed by the results of the digestion process.

"For secondary treatment, trickling filters or activated sludge will operate at rates in accord with the incoming load and the final results of the process as determined by turbidity, suspended solids and oxygen demand or dissolved oxygen and bacterial content. Rates of return sludge or amounts of artificially added oxygen will be controlled from the same device that determines the condition of the final effluent. Disinfection by chlorine or other disinfectant will be controlled by a continuous analysis of the bacterial content of the effluent and/or the chlorine required value. Sludge from both primary and secondary settling units will be pumped in accord with the rate of accumulation and will be

thickened automatically to the optimum water content. Rate of pumping and start-stop of operations will be in accord with the density or concentration of the sludge so that a constant composition of sludge-water ratio will be fed to the digesters.

"Whether or not new processes of treatment appear, there is no doubt that all sewage treatment plants can be made to run by automatic process as soon as the necessary sensing elements or analyzers are available."

How Automation Works

It is apparent from the definition of automation and from the description of the water or sewage plants of the future that there are certain essential elements to an automatic control system. These include: sensing element, transmission system, instrument or comparer unit, control unit, and power to do the work.

To understand how these elements fit into the operations of a water or sewage plant it is necessary to list the operations which have been performed by a human operator. These basic operations may be listed as follows:

1. Determine point where change is necessary; this determination may be based on the reading of meters or gauges, chemical analysis, or other observation.
2. Dispatch a command to perform or advise (start-stop or adjust equipment operation).
3. Sense error in process (human judgment).
4. Read instruments or make check analysis to compare changes with position or magnitude of result intended by command (feedback).
5. Note error and take corrective action to minimize new error (feedback).
6. Record data on the progress of the complete operation.

Any operating plant utilizing human decisions and efforts to perform step operations, will invariably be the victim of costly errors. Even when operating normally, an operator (or several) is being paid for merely standing by, a costly situation. When something goes wrong, human judgment is called upon to correct the fault. In performing this corrective action, the operator becomes the feedback mechanism, (step No. 5 above), and is limited in speed, response and ability to calculate the next move. It is this step No. 5 which is an essential in a true automation system. When the operator is bypassed or has substituted for him mechanical, electrical, hydraulic, pneumatic, or electronic devices, the automatic plant results.

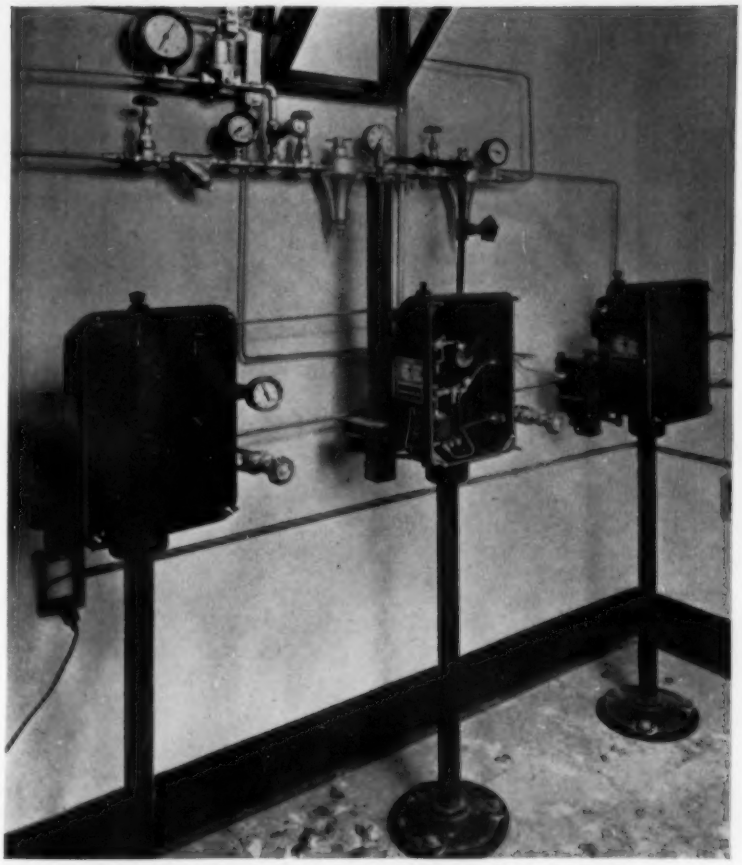


Fig. 4—RATIO computer transmission by air
Air-sewage ratio at Hyperion Sewage Plant, Los Angeles, Calif.

In water or waste treatment involving stepwise unit processes, complete automation is best accomplished by cascade or "piggyback" control. This system forms a series of linked control systems each controlling within its link, while the material being processed feeds into successive operations. Figure 1 shows a single feedback control system in block form. Figure 2 shows a cascade control composed of two links in which the output of the first becomes the command for the second. This cascade system can be built up stepwise to cover the entire operation of an automatic water or sewage plant.

Where Are We Today?

In discussing the status of automation in water and sewage works today, it is desirable to review both the equipment and the applications now in use. The best approach to this matter is to consider first, the four elements of an automatic control system: Sensing element, transmission, comparer unit, and control device.

Sensing Element

Today there exist excellent devices for the measurement of pressure, temperature, fluid flow, pH, oxidation-reduction potential and conductivity. All of these items have been in use for many years. More recent developments include devices for determining residual chlorine, turbidity, and dissolved oxygen. For completely automatic operation, we need improvement in the last three items mentioned, and we need wholly new devices for the determination of the optimum point of coagulation, the filterability of water, the fluoride content of water, the hardness of water, the chlorine demand of water and sewage, the B.O.D. of sewage, the bacterial content of both water and sewage, (perhaps the electron microscope). Also needed are devices for determining the ammonia, alkalinity and volatile acid content of sludge digestion tank liquor, moisture content of sludge, et cetera. And all of these devices must be capable of determining these characteristics on a continuous basis.

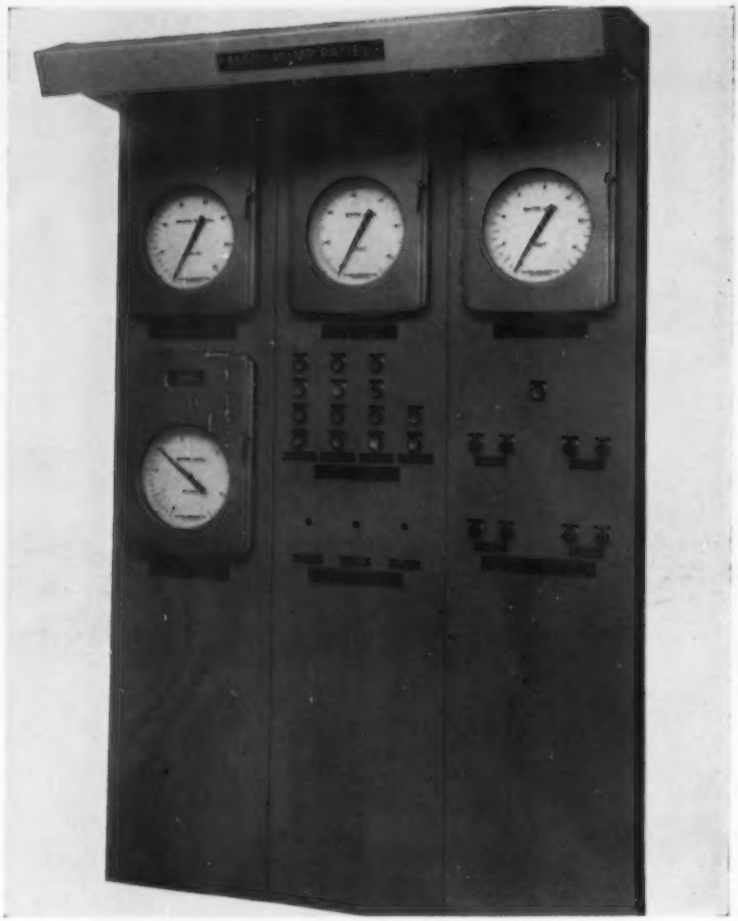


Fig. 5—CONTROL panel for pumps in sewage works

New sensing devices must have the same basic characteristic existing in present sensing elements. They must be able to convert the sensed information to some physical manifestation represented by mechanical motion (linear or rotational) pneumatic pressure (or mechanical motion), or electrical voltage or frequency. Electrical manifestations are generally preferred because of the ease of transmission over great distances, speed of response, and versatility in combining with other electrical data.

Transmission

There are many transmission systems available for use. These include direct mechanical linkage, hydraulic pressure, pneumatic pressure, electric signal, electronic signal, audio wave and radio micro-wave link. Probably best known in the sanitary engineering field are the mechanical link (cable), pneumatic (air pressure) and electric telemetering systems.

Transmission elements have long been used in remote supervisory control systems, especially where raw water pumps, deep well pumps or sewage lift stations are located at some distance from the main station. These supervisory control systems are used not only for start-stop of equipment and speed control but also to report back operating conditions such as running speed, valve position, bearing temperatures, pressures, flow, etc.

If a water treatment plant is located reasonably near the source of water, the problem of controlling and monitoring is greatly simplified. Multi-wire cables can be used for transmitting control functions or commands from the plant mixing basins to the pumps and feeding back operating conditions such as pump status, pressures, flow and other data which may be used to regulate other steps in the process or stored on charts for future expansion and efficiency studies.

If the treatment plant is located at some distance from the source of supply, the problem of remote control becomes involved because of the economies of the transmission system and therefore has a bearing on the ultimate control system chosen. The choice is always narrowed down to supervisory control over a single pair of leased telephone or private wires or radio (micro-wave link). In the final analysis, the choice usually goes to signal line transmission because of its simplicity, lower cost and lack of external interference from electrical obstacles.

Supervisory control systems for use over leased or private signal lines are classified basically as one of three types:

a. All relay pulse coded (G.E. and Westinghouse)
b. Tone coded (R-F Labs. and Hammarlund)
c. Scanning switch sequencing (Builders-Providence Synchro-Scan® Supervisory Control, Fig. 3)

Combinations of these basic types result in systems which can be described as:

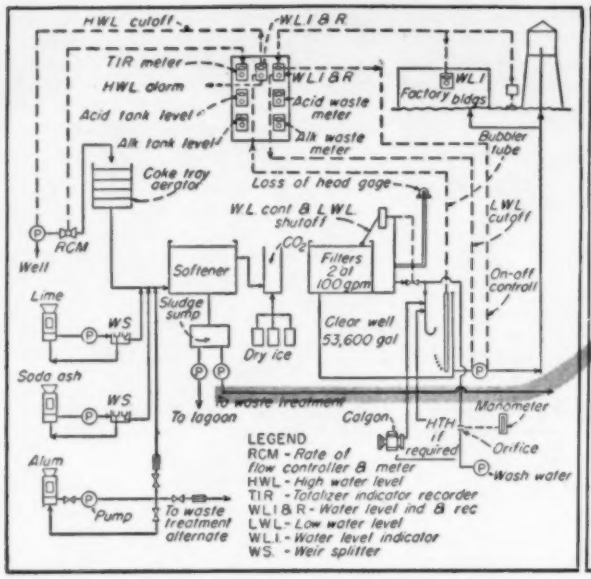
d. Relay and tone coded.
e. Relay tone coded and stepping switch.
f. Tone coded and scanning switch.

Of these several systems, the scanning switch sequencing type of supervisory control is an excellent system for use in water and sewage treatment processes because it was designed specifically for that field. The Synchro-Scan system can perform all of the automatic functions required in addition to report back and telemetering time-impulse or other types of measurements between plant and remote pump location.

For data transmitting, controlling, indicating and recording, there exists on the market today a variety of telemetering systems. Most of these are reliable and have been time tested; so it becomes a matter of personal preference when the designer chooses time impulse, tone, balanced bridge frequency shift or pneumatic system.

Comparer Units

Instruments for indicating, recording or totalizing almost any sensed data are already on the market and have been in use for many years. These devices are capable of being used to compare the data with set limits and of transmitting the deviation from those limits a short distance back to the control devices. Transmission can be by any of the methods mentioned but pneumatic, electric or electronic are to be preferred. Such data as flow, flow ratios (Fig. 4), level, pressure, concentration of chem-



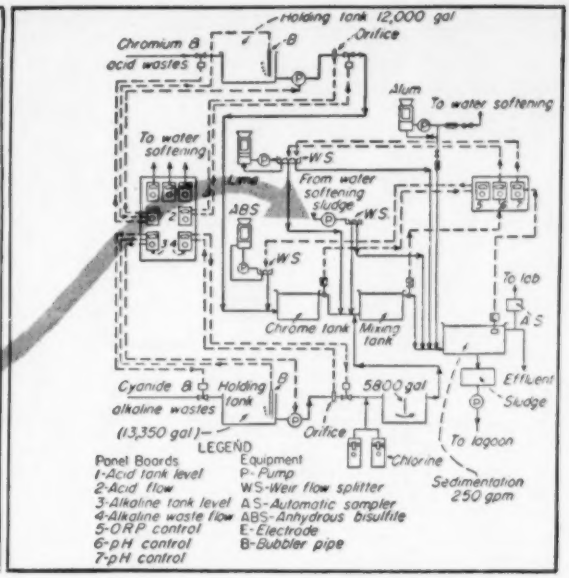


Fig. 6—DIAGRAM of industrial water softening control system **Fig. 7—DIAGRAM of industrial waste treatment system**

Note: Sludge from water softening is added to waste treatment for pH adjustment
(Diagram courtesy **Eng. News Record**)

ical characteristic, conductivity, oxidation-reduction potential, etc., can be handled by devices currently in use either in the sanitary engineering field or in the chemical process field. The adaptation of digital or analog computers to function as part of the comparer unit is quite possible, being used today in the process industries.

Control Devices

The necessary control units for automatic operation exist today. They include pumps, valves, chemical feeders (solids, liquid, gas), etc., all of which are in common use. Pumps, particularly centrifugal and gear pumps, with magnetic or variable speed drive, are ideally suited to complete automatic operation. Valves (particularly butterfly) operated by hydraulic, pneumatic or electric operators, lend themselves perfectly to the control of flow and level in automatic water and waste-water treatment.

Probably one of the best known control devices of automatic operation in water and waste-water treatment is the chemical feeder. Chemical feeders are divided into three types: Solids feeders, liquid feeders and gas feeders. Solids feeders may feed either on a volumetric basis or on a gravimetric basis. Gravimetric feeders may be either loss-in-weight or belt gravimetric types; liquid feeders may be volumetric feeders including decant types or positive displacement feeders including the Archimedes wheel (Rotodip) or loss-in-weight feeders, and the proportioning pump, either diaphragm or piston. Gas chemical feeders usually operate on the basis of volume measurement through an orifice under controlled conditions.

Dry Feeders

If automatic operation does not require a high degree of accuracy in rate of feed, volumetric feeders for liquids and solids may be satisfactory. On the other hand, if automatic operation requires chemical dosage to be as accurate as possible, the more accurate continuous loss-in-weight gravimetric feeders should be used.

A description of the loss-in-weight feeder as a control device will show how the unit fits into fully automatic control. This chemical feeder consists basically of a storage hopper containing several hours' or several days' supply of chemical. The hopper is mounted on scales and is counterbalanced by a scale beam and a counterpoise. Constant or variable speed drive means are provided to continuously retract the counterpoise by a lead screw. A feeder device and controller complete the assembly.

The desired rate of feed is obtained by adjustment of the rate of counterpoise retraction on the scale beam. An internal control loop is established, consisting of a scale beam, controller, and feeding mechanism, whose collective operation is to compare the instantaneous position of the scale beam against a reference point and to cause a loss in weight of material from the hopper. Thus, the controller actuates the feeder mechanism to feed out the proper amount of chemical continuously. The hopper is reloaded periodically as required. For high rates and continuous feed a twin hoppered feeder is available, one hopper of which unloads while the other is being filled at the same rate from storage.

This feeder can be made proportionally responsive to liquid flow rates in a plant when this flow is translated into terms of potential difference or a pneumatic pressure. The addition of pneumatic or electric positioners on the variable speed drive retracting the counterpoise will permit the control of the feed rate in response to the flow variable. Similarly, control of rate of feed from the measurement of some chemical characteristic in the water or sewage is possible when a sensing device is available to determine the desired characteristic such as pH, conductivity, ORP, etc. and convert that sensed data into electric, electronic or pneumatic values which can be transmitted back to the feeder lead screw drive.

Using a similar type of feeder and one of several available feeding devices, for example a gear pump driven by variable speed motors, permits liquid of any viscosity to be fed on a loss-in-weight basis in response to conditions of flow and chemical or physical characteristic of the liquid undergoing treatment.

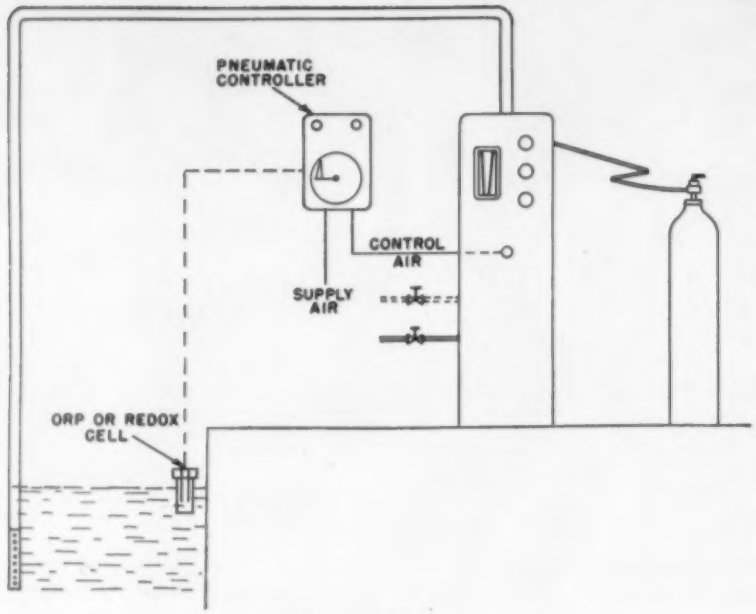


Fig. 8.—DIAGRAM of automatic chlorine feeder control

Proportioning Pumps

Solutions of coagulants, fluorides, softening chemicals, etc. can be fed by solution feeders of all types and automated solution feeding for clarification, sterilizing, softening, stabilizing or corrosion control is even now becoming more common with large water supplies. The primary sensing instruments are pH and Redox and conductivity meters, sometimes in combination with flow meters. The comparatively stable conditions and large chemical capacities in most water supply systems do not normally require extremely accurate solution feeders except as a convenience in materials handling and to give more accurate inventory of chemicals used. But it must be remembered that control of chemical dosage means economy of operation. Automation, with an end-point control, calls for a regulating device rather than a metering device in handling solutions.

In the case of industrial waste treatment the control problem is so difficult that the simple regulating device, such as a valve, swing pipe decanter, conveyor, etc., may not be satisfactory. To neutralize and clarify waste products from process plants may well require a high retention factor, automatic control by a primary element and a metering device for the final control element. The process load in waste treating can vary over such wide limits that stable automatic control is virtually impossible. Measuring and control lags and wide capacity variations can often be minimized by use of a more accurate final element whose response rate can be accurately predicted.

As an example, the solution reuirement for acid waste neutralization would be the product of the pH and the flow. At certain operating levels in the plant due to seasonal or work shift changes the range of variation in these factors might change in a predictable way. A very difficult control problem can be simplified by using a holding tank to equalize flow and concentration. In lieu of this arrangement, a solution feeder can be used whose response range can be shifted. Thus flow and pH can be integrated and used to regulate the speed of a final element such as a proportioning pump, the anticipated range of variation can be set by changes in stroke length so that overall response becomes far more uniform.

A proportioning pump in itself can be used as an integrating device wherein flow controls the speed of the pump and pH controls the stroke length.

This type of operation involves very wide variation in solution rates at comparatively low levels, from many gallons to fractions of a gallon per minute. These conditions are fairly typical in industrial waste treatment. Water supplies generally have a more uniform, high level demand for treating chemicals and solution feeding is not the usual approach at present but may become more general in the future if Mr. Rogers' prognostications hold true.

Today's Applications

As might be expected, the first unit process in sanitary engineering to come under automatic control was that of pumping. Control of pump operation has long been possible from the level in reservoirs or pressure in elevated tanks, with start-stop operation in accord with the sensed condition in reservoir or distribution system. (See Fig. 5)

An advance in automatic pump operation came with the introduction of the Pressureflo Control System whereby the pump operation on a distribution system was started and stopped according to the demand for both flow and pressure. This combination of pressure and flow as the controlling information assured customers that their requirements would be satisfied at all times. In connection with this automatic operation of pumps, it has been possible to set up sequencing cycles so that where multiple pump installations exist, each pump is operated in turn and for time periods that insure equal wear on the individual units.

Semi-automatic operation of chemical feeders and other auxiliary equipment has been successfully practiced for many years, particularly where it has been desirable to pace the chemical feed rate proportionally to the flow of liquid being treated. (See Fig. 6 & 7) Step and program time-cycle controls have also been used for chemical treatment.

An approach to the automatic plant came within recent years when the operation of a whole water treatment plant was started and stopped according to the level of water in the elevated storage tank. In this case, well pumps, aerators, lime softening, sedimentation, filtration, fluoridation and chlorination started and operated as an integrated plant on a signal from a low water level in the elevated storage tank and operations stopped on a high water level signal. This is not a true automatic plant, however, since an operator has to set the chemical dosage rates and backwash the filters.

Automatic operation of filters has been possible and in use for some time. One type of automatic filter control is Auto-Central® Control. With a minor adjustment in this equipment, it is possible to have filters cut out of service when the loss of head reaches the maximum allowable and thereafter to be put through a washing cycle (including two washing rates) for time-cycle controlled peri-

ods of washing, and to be returned to service when the washing cycle is completed. Installations of the "Auto-Central" Control System use a warning system to advise the operator when the filter is ready to be washed and he, in turn, pushes a button which initiates the washing cycle. It is easy, however, to bypass the operator entirely and wash the filters automatically. There are other automatic filter control systems.

Automatic control of alum feeders from the turbidity of the settled water is now in use in a plant in California. Several automatic turbidity measuring and recording devices are now available and need only refinements to make them fully acceptable for complete control of coagulation or softening on the basis of turbidity and flow.

Automatic control of gas chlorine feeders from a continuous determination of the residual chlorine is now in use in several locations. This system of control has been used in both water and sewage treatment. Control of oxidation-reduction reactions, e.g. the reduction of hexavalent chromium or the oxidation of cyanides, is entirely feasible and is now in use based on the oxidation-reduction potential. (ORP or Redox—Fig. 8) Some studies have been made of the importance of ORP in sewage treatment processes and these offer highly interesting speculation as to the possibility of putting the Redox potentiometer to use in the control of sewage treatment processes.

Control of fluoride addition is currently being done by conductivity measurements of the water before and after addition of the fluoride chemical, and studies are now being made on the use of conductivity measurements in the control of coagulation.

Control of acid neutralization from continuous pH recording cells is common-place in many industrial waste treatment installations of that type. In all of these cases of automatic control, present day devices for flow measurement are used as an integral part of the control system. In the activated sludge process, for example, ratios of air to sewage and of return sludge to sewage are now being sensed by flow meters and the ratio calculated by analog devices which transmit the data on ratio to gauges in the central control station where the operator can adjust either flow to obtain the ratio he wishes. It is a simple step to adapt this system to automatic control wherein the actual ratio can be constantly compared to the desired ratio and the flows change automatically by signal from the computor device.

As indicated previously, remote supervisory control including the operation of pumps, chemical feeders, valves, filters, etc., has been applied in numerous locations in this country as well as abroad. Thus it is apparent that automation in some of its aspects is already an important part of the functioning water or waste-water treatment works.

Future of Automation

Obviously, not every manufacturing or treatment process can become completely automatic in the strictest sense. In the field of sanitary engineering, however, automation is more than just a possibility. It is on its way to becoming an accomplished fact.

In discussing the subject of automatic operation before the Pennsylvania Water Works Assn. in October 1955, Harry E. Jordan, Secretary of the Amer. Water Works Assn. said: "The 'fear-complex' appears to affect the attitude of some water works engineers and operators in considering the application of certain modern inventions to the operation of water works equipment." Then Mr. Jordan recounted a number of automation applications in water works much as outlined above, except that he gave specific locations.

Mr. Jordan continued: "Supervisory control of automation of water works installations is growing so rapidly and so convincingly that it appears to the writer that any sizeable program, presently in the planning or drafting room stage, must give consideration to the extent of automatic control or automatic recording of information that would improve the operation of the system."

Part of the "fear complex" about automation in this field as well as in others is the fear that machines will replace manpower and that automation costs too much. It is true that automation to some extent does and will reduce manpower required but that is not the essential reason for adopting automation. On this point, Mr. Jordan commented in these words: "Let it be said at this moment that the objective in the writer's thinking is not to reduce the amount of manpower required to operate the water works system. Rather, it is to improve the service to the public through the supplementation of manpower by modern mechanical and electrical equipment . . . Automation is not essentially a substitute for manpower—it is a supplement to manpower. . . ." Regarding costs, Mr. Jordan said: "A rather obvious answer to all this chatter about automation is that it costs too much. A simple rejoinder is that human mistakes cost too much."

There is no doubt that Mr. Jordan's ideas will come to prevail and that automation will become more and more important to the field of sanitary engineering. We may expect to see the application of automation advance most rapidly in the areas where it is already established, such as pump control, flow control, filter operation, chlorination and chemical treatment involving neutralizing and oxidation-reduction reaction.

We may expect perhaps slower but still certain advances in the control of chemical treatment involving processes utilizing chemical reactions, e.g. coagulation, softening and iron removal. We may expect even slower advances in the control of biochemical oxidation, sludge digestion, etc., not only because of the necessity of developing adequate sensing elements but because enzymatic and biological reactions are still not fully understood. That new sensing devices will be developed, the authors do not doubt, but unfortunately our crystal ball does not indicate how soon. We do know, however, that we have already climbed part way up the stairway of automation and it appears that we may reach the top in the not too distant future.

Acknowledgment

The writers are indebted to M. E. Rogers and W. H. Brown of Builders-Providence, Inc. for their ideas on the plants of tomorrow; to A. A. Melnychuk, Chemical Engineer, Omega Machine Co. for information on solids feeders; to J. R. Hefler, Research Engineer, Proportioneers, Inc. for information on proportioning pumps, and to Dr. George E. Symons, Consultant & Technical Editor, for editorial assistance in the preparation of this article.

W&SW

Fort Wayne to Improve Sewerage Facilities

Fort Wayne, Indiana, is having a comprehensive survey and engineering report made of its sewer system in an effort to remedy the problems arising from its overtaxed sewer system and the overloaded sewage treatment plant. The report will designate improvements needed immediately and also long range requirements for the rapidly developing Fort Wayne area. Work on the survey has been started by the engineering firm of Consoer, Townsend and Associates, of Chicago.

REMOVAL of insoluble manganese coatings on units was possible in this plant by addition of 1 ppm of copper sulfate

Copper Sulfate Aids in Manganese Removal

Experiences at Rock Hill, South Carolina

by **HOWARD H. CHAMBERS** and **ROBERT S. INGOLS**

Respectively, Superintendent of Water Treatment, Rock Hill, S. C., and Research Professor, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga. **This article describes how oxidation of manganese in a raw supply to insoluble oxides was relieved by treating with small dosage of copper sulfate to form soluble manganic dioxide.**

THE CITY of Rock Hill, S. C., is located near the Catawaba River, from which it draws its raw water. Three miles above the river pumping station is located a dam of the Duke Power Company which is used to generate power on demand. The presence of the power dam assures the city of an adequate volume of water in the river in relation to their requirements. The town has approximately 30,000 population, with a large textile finishing and dying plant and several smaller weaving and bleaching mills. The total water pumped from the Catawaba River averages 15 million gallons per day, whereas the minimum river flow below the dam is approximately 400 million gallons per day.

In view of the very severe droughts in the Rock Hill area for the 1954 and 1955 summer seasons, it is fortunate that the dam was able to provide plenty of water for the city of Rock Hill and its industries. The city uses only open channel flow from the dam to the site of the water intake.

Two water treatment plants are in

use in Rock Hill. The large finishing and dyeing plant operates one plant, which is capable of producing 12 mgd. The city operates the small plant, which produces the potable water for both domestic use and the smaller textile plants. Only experiences at the city-operated smaller water plant will be described in this article.

In the design and operation of hydraulic power generating stations, every effort is made to obtain a smooth flow of water through the intake duct, against the fins of the turbine, and then a smooth flow away from the discharge port. Entrapped air would be very undesirable. In a properly constructed station, all of the energy of flow and head is expended in the turbine and not in turbulence in the inlet or outlet ports. This means that the inlet tube is at the point of maximum depth still possible for flow from the outlet with minimum turbulence down stream.

Because of the need for a deep intake, the water below a power dam is drawn from the deepest layer. During the summer months the chemical quality of this water is poor by comparison with that of the surface water. However, the surface water, some 10 to 15 feet deep, is warmer than the deep water by several degrees because of the limited penetration of the sun's rays. The lower layer of water, which is cooler, is more dense and does not mix with the surface layer because of this difference in density. Algae grow in the surface layer, but on dying they fall into the bottom layer where they act as food for bacteria. Because there is no mixing of the layers and no sunlight to produce oxygen by algal action, the dissolved oxygen frequently is entirely depleted from the deep layer. When the dissolved oxygen is used up, the quality of water downstream is adversely affected because of the low dissolved oxygen content and the solution of by-products of anaerobic activity.

When organic matter has accumulated on the bottom of a lake, bacteria grow on the organic matter. In the presence of dissolved oxygen bacteria obtain the maximum amount of energy which is available in a given amount of food. When the dissolved oxygen is no longer available, the bacteria can get almost as much energy from the same amount of food when some nitrate ion is present to supply combined oxygen. However, in the complete absence of dissolved oxygen and available combined oxygen, the food can still be used: most of the original energy in the food remains in the by-product alcohol. From the data in Table 1, it can also be seen that the oxygen in manganic oxide can be used profitably to obtain energy from a given amount of food (if the manganic oxide is soluble enough to be available to the bacteria). Possibly the by-product hydrogen sulfide of the lowest energy-yielding reaction is responsible for the reduction of the manganese material. However, whether the reduction of the manganese mineral takes place inside of or external to the bacteria is not pertinent to this article. Manganous ions are produced and persist as such in the presence of oxygen under natural stream or reservoir conditions for days without a catalyst.

TABLE 1

Energy Obtainable by Bacteria from One Gram-Molecular Weight of Sugar Under Various Conditions

Sugar Combines With	Sugar Product	Other Products	Net Energy, Kcal
Molecular oxygen	$CO_2 + H_2O$	None	673
Nitrate ion	$CO_2 + H_2O$	N_2	532
Sulfate ion	$CO_2 + H_2O$	H_2S	133
Manganic oxide	$CO_2 + H_2O$	Mn^{++}	273
——	$C_2H_5OH + CO_2$	——	17

This paper describes an experience with large amounts of manganous ion in the Catawaba River during June, July and August 1955. During a visit to the water plant in late June, an observation was made of the sight well. At first glance, it appeared that the switch was broken or that the light was burned out. Inquiry revealed that neither was correct, but that the walls of the sight well were black. No chemicals were available for determining manganese, but the appearance of the well made the diagnosis so obvious that further evidence seemed unnecessary.

The filters appeared normal and filter runs of 120 hours were being obtained. The chlorine dose had been increased from 1.0 ppm to 1.5 ppm and soda ash was added to the flocculated water to obtain pH 8.0 with no apparent improvement.

The raw water is pumped directly from the river to the mixing basin. This meant that no prechlorination with adequate detention time was possible. The plant had copper sulfate crystals in storage. Futral and Ingols* have discussed the use of copper sulfate as a catalyst for the oxidation of the manganous ion to manganic dioxide. The U. S. Public Health Service permits 2.0 ppm copper in drinking water for interstate carriers. It was recommended that 10 pounds of copper sulfate crystal be added to the mixing well uniformly each shift. This would be the equivalent of 1 ppm of the crystal (or 0.25 ppm copper).

Shortly after the recommendation was made a carboy was placed on the mixing basin wall and the necessary copper sulfate for that shift was dissolved. A siphon from this vessel was started and adjusted by the operator to drip into the well in order to use all of the solution per shift. This was continued for several weeks. Within hours after the copper sulfate dosing began, the appearance of the settling basins changed; then the sand filter surface turned black. The filter runs changed from 120 hours to 50 to 60 hours, indicating a much heavier floc load. A careful check of the filtered water was maintained to be certain that enough chlorine was present to permit completion of the oxidation reaction.

The sight well was emptied one weekend, with a full clear well, and the walls scrubbed with acid to clean them. After practicing the addition of copper sulfate to the mixing chambers no more manganic oxide or ferric oxide coating of the sight well occurred.

When the filter runs returned to the normal 120 hours and the manganese in the raw water was found to be less than 0.1 ppm, the dosing with copper sulfate was discontinued.

Acknowledgement

The authors wish to acknowledge the cooperation of the firm of Wiedeman and Singleton, by whom Professor Ingols was temporarily employed, and the City of Rock Hill, S. C., for permission to publish this material.

*Futral, F. L., and Ingols, R. S., "Copper Catalysis for Manganese Oxidation." Jour. A.W.W.A., *45*, 804 (1953).

WATER WORKS PRACTICES

Filtration — Part 3*

The Thirtieth of a Series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

7 . . OPERATION

a. *Preparation of water* for filtration consists of coagulation, flocculation, sedimentation and sometimes chlorination.

(1) The better the preparation (i.e. the more foreign matter removed by sedimentation), the longer will a filter operate before washing is necessary and the better the results of filtering.

(2) Improvements in preparation techniques made possible highrate filtration.

(3) Where taste and odor removal are desired, filtration is not effective without some pretreatment consisting of free residual chlorination or activated carbon treatment.

b. *Filter loadings* are expressed in terms of coliform bacteria in the raw water.

(1) Streeter (Jour AWWA, *31,* 1947; 1939) of USPHS developed a guide to maximum bacterial pollution possible if a filtration plant is to produce an effluent which meets the PHS "Drinking Water Standards."

. . . This loading relation is expressed by the equation:

$$E = c\,R^n$$

where E = coliform content of finished water;
R = coliform content of raw water;
c = coefficient reflecting relation of raw to effluent coliform content; and
^{n} = coefficient indicating relative shift in effluent content with change in raw water content.

(2) Since filter action alone does not govern the results of a water purification plant, Streeter's guide considers other treatment processes. When E is 1 per 100 ml (USPHS Standards) the loadings permissible and treatments are as follows:

. . . Coagulation, sedimentation, filtration and post-chlorination will handle a monthly average loading of 5000 coliform per 100 ml, if less than 20 per cent of the samples contain more than 5000 coliforms per 100 ml.

. . . Presedimentation and prechlorination plus coagulation sedimentation, filtration and post-chlorination are required if the monthly average coliform content is 5000 per 100 ml and more than 20 per cent of the samples contain more than 5000 coliforms per 100 ml and no more than 5 per cent of the samples contain up to 20,000 coliforms per 100 ml.

. . . Prolonged preliminary storage plus pre-chlorination, coagulation, sedimentation, filtration and post-chlorination if the raw water coliform content averages more than 5000 per 100 ml.

(3) Permissible loadings of color, turbidity, iron and organisms larger than bacteria have not been expressed mathematically, but adequate removals are possible with treatment processes adapted to meet existing conditions.

c. *Rate of flow* through the filter has been discussed previously in Section C-6 and need not be reviewed under this section on Operation.

d. *Filter runs* are measured in hours from the time a clean filter is placed in service until the head loss is such that washing is again required.

(1) Length of filter run varies with a number of factors.

. . . Directly as the amount of suspended matter in the applied water, although there is no exact relation.

. . . Directly with the size of sand grain; i.e., the smaller the grain the shorter the filter run.

. . . Directly with the porosity; i.e., the greater the percentage of voids, the longer the filter run.

. . . Indirectly as the rate of filtration; i.e., the higher the filtration rate, the shorter the filter run. Baylis reports that filter runs at 5 gpm per sq ft are half as long as those when the filtration rate is 2 gpm per sq ft.

(2) Baylis (Jour AWWA, July 1937; pp 1010 and 1044) proposed a relation between filtration rate and length of filter runs as:

$$H = \frac{K}{M^{1.5}}$$

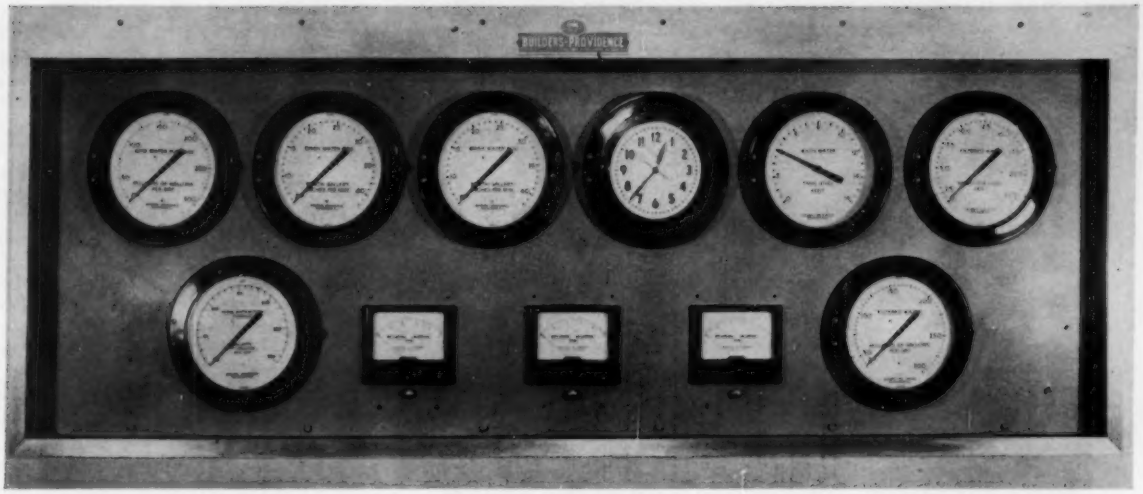
where H = filter runs in hours;
K = constant depending on clogging tendency of applied water; and
M = filtration rate in gmp per sq ft.

. . . According to Baylis, K varies between 52 and 90.

(3) Condition of the applied water affects the length of filter run, as indicated by Baylis' constant K.

. . . Water plants with good preparation of water before filtration may

* *Ed. Note*: Part 1 of this article on filtration appeared in the March issue, Part 2 in April. This third installment concludes the subject.



PANEL of gauges showing wash water operations—Nottingham Plant, Cleveland, Ohio

expect filter runs of 40 hours or more.

. . . Filter runs average approximately 24 hours.

. . . Filter runs of 12 hours or less may be caused by a variety of factors (See "Operating problems").

e. *Operating problems*

(1) A serious operating problem is short filter runs, caused by several varied factors.

(2) Air binding, or the formation of air pockets between the voids in the sand bed, cuts off the filtering area and reduces filter runs, if the condition becomes severe.

. . . It is caused by the separation of dissolved air from the water under less-than-atmospheric pressure.

. . . Downward passage of the water prevents the escape of the air from the bed, while the pocket grows in size and reduces filtering area and capacity.

. . . Air binding may occur in cold water supersaturated with dissolved air; or if a negative head (vacuum) occurs during filtration, thereby facilitating release of air from solution; or where supersaturation of oxygen occurs due to prolific algae growth, the excess oxygen being easily liberated in the filter.

(3) Clogging of filter beds by microscopic organisms which have a specific gravity of approximately 1.0 and therefore add no weight to coagulant flocs to aid in settling.

(4) Mudballs which are formed of a mixture of sand, coagulant, bacteria, algae and other zoogleal and organic matter, often "grow" to a large size, working their way downward to the bottom of the filter and effectively reducing filtering area.

. . . Mudballs cannot be broken up by ordinary back washing, and if not removed or destroyed may form large areas of "mud" in a layer.

(5) Clogged areas occur due to cementation of the sand grains with mud balls or material from which mud balls are made.

. . . Shrinkage of the sand bed causes increased loss of head; cracks occur, particularly at side walls, allowing unfiltered water to pass through the cracks.

(6) Tastes and odors may be caused by filters containing large amounts of mud balls or by growths of algae organisms on the walls and filter troughs.

(7) Partial clogging of underdrains may occur due to the deposition of carbonate, iron, manganese or biological growths.

(8) Growth of sand grains, particularly in water softening plants, due to the deposition of calcium carbonate on the sand grains, or to depositions of iron or manganese.

f. *Remedies* for operating problems include:

(1) Frequent washing to eliminate air binding when it occurs.

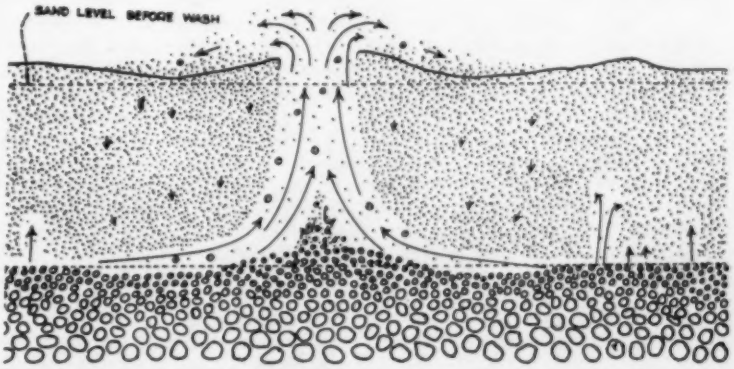
(2) Improved washing facilities, including higher wash rates and surface washing, to eliminate mud balls, clogging and cracks.

(3) Pre-chlorination, just ahead of filters, to kill algae growths, reduce tendency to odors from "mud" and to "sweeten" the filter.

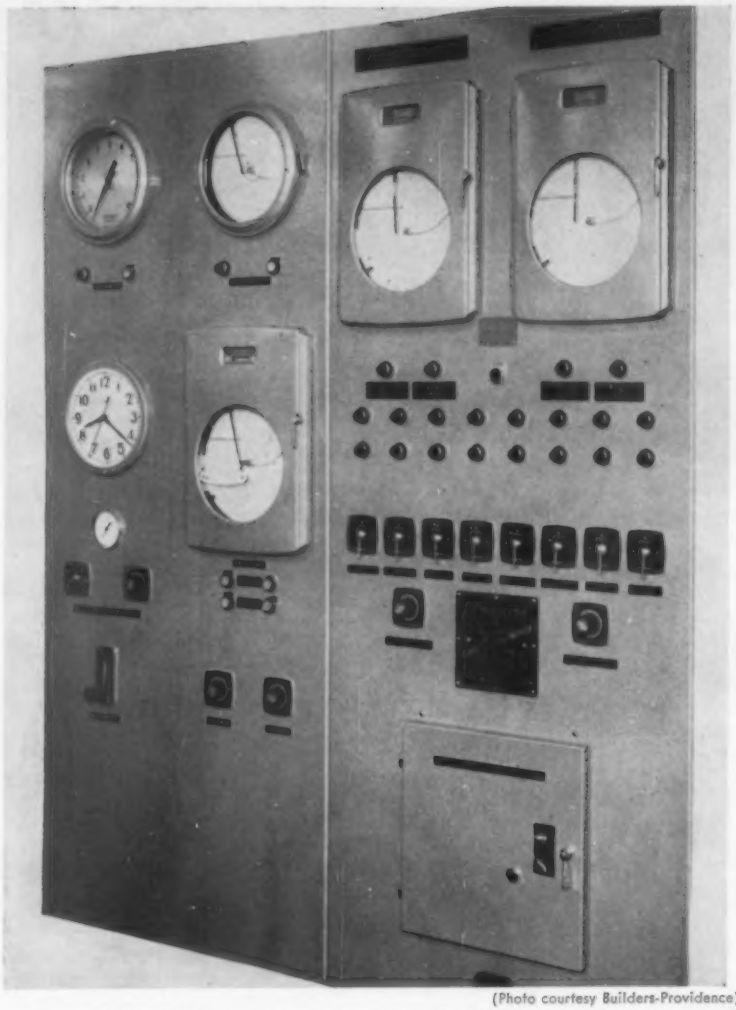
(4) Remove filters from service where severe algae growths exist on the walls and treat idle filter with a strong hypochlorite solution.

(5) Treat idle filter with a solution of hydrochloric or sulfurous acid.

. . . Inhibited hydrochloric acid may be added at the top of a filter and allowed to move downward through the filter to the drain or "rewash" line, or it may be added to the



SAND BOIL formation (After Baylis). Diagram shows sand boil forming at start of wash. At same time gravel is being pulled toward the boil and is piling up at the bottom of it



(Photo courtesy Builders-Providence)

AUTO-CENTRAL control panel for automatic filter operation control

underdrain system and forced upward through a filter out of service; a special tap in the drain line is needed for this purpose.

. . . Sulfurous acid, produced by adding sulfur dioxide gas to the effluent line or drain line of a filter, is excellent for cleaning filters suffering from clogging of any kind and for removing carbonate, iron and manganese deposits.

A 150-lb cylinder will make 6,000 gal of 0.3 per cent solution, a desirable concentration.

(6) Remove sand, and gravel, if necessary, wash thoroughly and replace, or replace with new filtering medium if other treatments fail to produce desired results.

8 . . Filter Washing

a. *Filter washing* consists of passing filtered water upward through the sand bed.

(1) The rate of upward passage must be sufficient to lift the sand grains and suspend them in the liquid.

(2) A measure of the proper amount of wash water is the amount of expansion of the sand bed.

. . . Fifty per cent sand expansion is considered desirable for adequate filter washing.

. . . Measurements of sand bed expansion may be made by a protected light on a calibrated rod or a hollow counterweighted cone as described in Section C-5-g.

(3) Rate of wash water application is measured in terms of inches of wash water vertical travel per minute, termed wash water use.

. . . Older filter plants were designed for 15- to 24-in. vertical rise per minute; modern plants are designed for at least 30-in., many for 36-in., and some for 48-in. rise per minute.

. . . The larger the sand grains the higher the wash water rise to obtain a 50 per cent bed expansion.

. . . Water at 32° F requires a lower wash water rise per minute to effect 50 per cent expansion than does water at 70° F; for small grains (where 30 per cent are less than 0.40 mm) the ratio is 1:1.65, for large grains (where 30 per cent are less than 0.80 mm) the ratio is 1:1.35.

(4) Upward velocity of the wash water not only expands the sand bed; it shears off dirt, floc, etc., adhering to the sand grains; it causes the grains to rub against each other thereby knocking the "dirt" loose; and it carries the loosened dirt up and out of the sand bed to the overflow troughs and thence to the sewer.

b. *When to wash* filters was set forth by Baylis (JAWWA, *46*) 176; 1954) in the following rules:

(1) When the head loss reaches 8 ft.

(2) When the head loss is approaching 8 ft on a group of filters during short filter runs.

. . . When a head loss of 7 ft is reached during times of very short runs.

(3) When a filter has had 48 hr of service, regardless of loss of head.

(4) When the rate of flow on a manually-rate-set filter begins to drop and loss of head remains constant or continues to rise.

(5) When loss of head is 6 to 7 ft with a low rate of flow on a filter operating at a variable rate of flow (from a master control setting) and an increase in demand is expected.

c. *How to wash* a filter has also been set forth by Baylis in the same article, which described practices at Chicago's South District Filter Plant. This procedure may be paraphrased to fit plants in general.

(1) Close influent valve and allow filter to drain down or dump water above filter troughs to sewer.

(2) Close filter effluent valve.

(3) Place sand expansion gage in operation.

(4) Open wash water valve slowly.

. . . Where surface wash is used, start surface wash at same time.

(5) After one minute open wash water valve full or until sand expansion gage shows 50 per cent value.

(6) Wash at maximum rate for 3 to 6 minutes, or until the wash water is clear enough to see the surface wash equipment. These time values will vary for different plants.

(7) Cut off surface wash water, then start to close wash water valve,

allowing final closing to be slow so that upward velocity of water will decrease gradually and allow proper reclassification (stratification) of sand.

(8) Where air binding occurs, washing should be started at a low rate to avoid sand eruptions, that is sand boil formation (see accompanying sketch).

. . . The practice of "bumping" a filter to eliminate air binding by opening and closing the wash water valve quickly was an operating procedure born of expediency years ago to increase filter runs where capacity was limited.

This procedure is undesirable, as it disturbs the sand bed, creates sand boils and allows foreign matter to be loosened and carried deeper into the bed and even to the filter outlet.

d. *To place a filter in service*:

(1) Close the wash water overflow drain valve.

(2) Open the influent valve slowly to avoid disturbing the surface of the sand.

(3) If filter-to-drain line is provided (sometimes termed "rewash" line), open this valve and allow filter to operate a few minutes.

. . . In older filtration plants, filtering to drain before placing the filter "on the line" was necessary for two reasons: (1) raw water was used for washing and (2) washing at low rates did not get the filter clean; in both cases the first water to leave the filter was not free of turbidity and bacteria.

. . . Modern plants with high-rate washing, surface washing, and filtered and chlorinated water for washing do not need these filter-to-drain lines.

(4) Open filter effluent valve, check rate of flow and cut off sand expansion indicator system.

e. *Amount of wash water* required depends on the rate of wash water rise and duration of the wash, the latter being a function of the dirtiness of the filter.

(1) Flow rates of 15 gpm per sq ft will produce a wash water rise of 24 in. per min; 22 gpm per sq ft will produce a rise of 36 in. per min; and 36 gpm will produce a rise of 60 in. per min.

(2) Good filter plant operation aims to keep the total amount of wash water as low as possible.

. . . Wash water used may vary from 1 to 6 per cent of the total water filtered, depending on the plant, the preparation of the water before filtering, operating procedures and conscientiousness of operators.

. . . Average wash water use is 2 to 3 per cent in well-operated plants.

(3) Modern plants include equipment designed to keep account of wash water operations. These include:

. . . Measuring, recording and totalizing meters on the main wash water line.

. . . Indicating, recording and totalizing meters on each filter wash water line.

. . . A rate controller on the wash water lines to maintain the proper rate of wash water flow to produce the desired 50 per cent sand bed expansion.

. . . Some plants have special wash water storage tanks, others use water direct from a high-pressure service system.

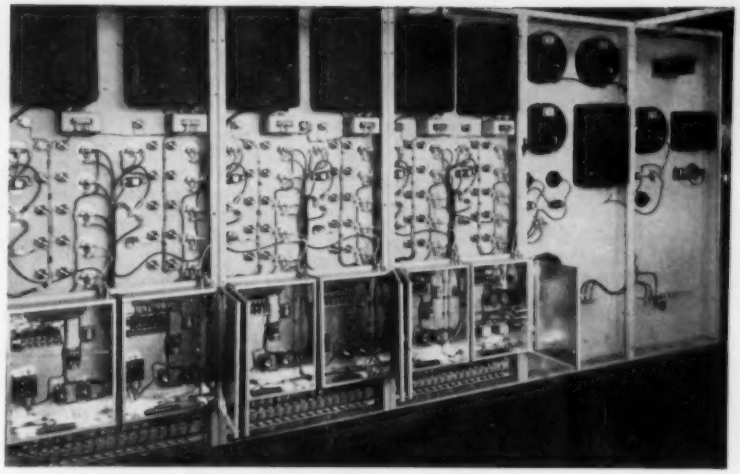
f. Automatic filter washing operation is possible with modern control equipment.

(1) Initiation of the washing operation may be on a time cycle or from loss of head measurements which will either trigger the automatic operation or produce a warning to indicate to the operator the need for washing, after which he can institute the washing cycle at the push of a button.

(2) This Auto-Central Control system, as it is termed, consists of a central control panel, where a master control rate setter can be provided to change the effluent rates of all filters simultaneously, from a single master adjustment.

. . . Sequencing controls put each filter through the washing cycle in proper turn, shutting it off, draining, washing, and cutting it back in.

. . . A backwash timer provides two or more backwash rates (an initial low rate to break the sand surface, expel air and provide maximum scrubbing action between the grains, followed by a high rate to produce full bed expansion and a final low rate to permit reclassification of the sand.



BACK of Auto-Central control panel, Ardmore, Okla.

. . . Washing rates and durations can be set at the master control board.

. . . Surface wash operations can be included in the washing cycle.

. . . Individual filters can be operated manually both as to rate and washing operations by transferring the control for that filter from automatic to manual.

g. *Auxiliary scouring action* to obtain greater rubbing together of sand grains is desirable and practically a necessity to insure a completely clean filter bed after washing, even at the higher rates of wash water rise.

(1) The first system used consisted of rotating mechanical rakes from which came the term "mechanical filter."

. . . These rakes reached to within a few inches of the gravel and were rotated at 8 to 10 rpm during washing.

. . . Mechanical rakes have not been incorporated in filter plant design for several decades.

(2) Air wash, next used to obtain extra scouring action, consisted of blowing air into the bottom of the filter at rates of 3 to 5 cfm per sq ft for 12 to 15 minutes before washing with water.

. . . Air was usually introduced through a special distributing grid above the gravel.

. . . Since air alone often caused little movement of the sand or channelled upward through the bed, designs of underdrain strainer heads were developed to allow both water and air to be passed upward through the bed at the same time.

. . . Air wash is seldom included in new plant designs, and seldom used in old.

(3) Surface wash is the method of auxiliary scour in current use.

. . . As described in Sect. c-5-h, the surface wash system may be either fixed or rotating.

. . . Surface wash adds from 10 to 30 per cent to the wash water rise rate.

. . . As indicated previously, surface wash is commenced just as the wash water is turned on and is operated while the bed is expanding.

Some operators discontinue surface wash when the bed expansion has reached 10 per cent; others continue the surface until near the end of the washing period.

h. *Cost of operation* of rapid sand filters is higher than that of slow sand filters, but construction costs are lower for the rapid sand filters.

(1) Operating costs vary widely ($10 to $20 per mil gal) depending on treatment required, amounts of chemicals used, length of filter runs, labor rates and conditions, etc.

(2) Other factors affecting costs include the frequency with which sand must be added to a filter to maintain the desired filter bed depth and the occurrence of sand boils, which may require maintenance procedures.

(3) Depreciation rates on rapid sand filters are higher than for slow sand filters.

9 . . Results

a. The purpose of filtration is to remove foreign matter from the water.

b. As indicated previously, the efficiency of bacterial removal depends on the content of the raw water and effectiveness of pretreatment.

(1) Regardless of the effectiveness of filtration for bacterial removal, post-chlorination is considered advisable as a safety factor.

(2) Post-chlorination helps to reduce aftergrowth in the distribution system.

c. Algae and diatoms will be removed by filters but tastes and odors caused by these organisms will not be removed to any appreciable degree.

d. Removals of other substances vary.

(1) Turbidity can be reduced to less than 1 mg per liter (1 ppm) when the filter is clean.

. . . This value tends to rise as the filter becomes dirty or if cracks develop as the head loss increases.

. . . Cotton plug filters attached to the filter effluent line will indicate passage of floc or activated carbon.

(2) Color removal is generally low.

(3) Oxidized iron and manganese will both be removed, although manganese removal is slower.

D . . . Pressure Filters

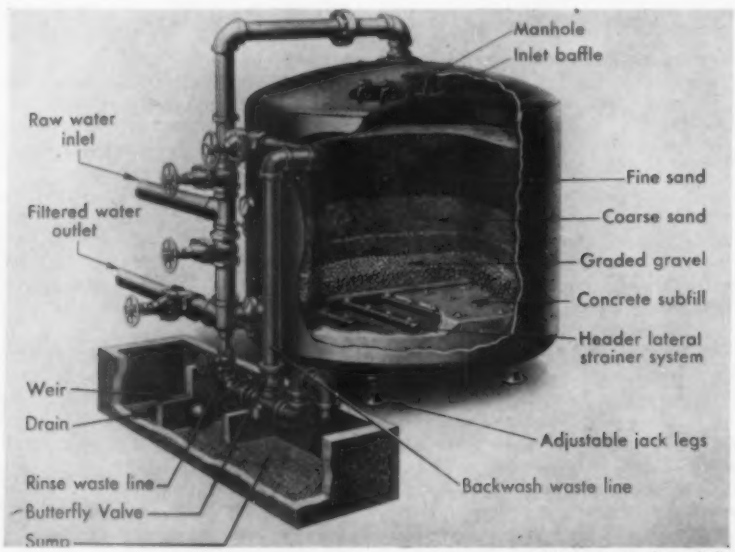
1 . . Design

a. Pressure filters are essentially rapid sand filters encased in airtight cylindrical tanks.

(1) The elements include underdrain system, gravel, graded sand, influent, effluent, wash and drain lines, with the necessary valves.

(2) Since the system is closed, water passes through the filter under pressure, with the head loss being only that necessary to force the water through the filter bed.

(3) Pressure filters may be either vertical or horizontal.



(Photo courtesy Permutit Co.)

CUTAWAY of vertical-type pressure filter

b. Capacities available depend on the design.

(1) Horizontal tanks—max 8 ft dia by 25 ft long—0.75 mgd at 3 gpm per sq ft.

(2) Vertical tanks—max 10 ft dia by 10 ft high—0.35 mgd at 3 gpm per sq ft.

c. Factors affecting choice of pressure filters.

(1) Limited capacity.

(2) Limited space available.

(3) Relatively low turbidities acceptable without sedimentation.

(4) Need for pressure system operating from one set of pumps.

(5) Possibilities for pretreatment.

(6) Adaptability for manufacturing processes.

2 . . Operation

a. Pretreatment is desirable, but the extent and character of pretreatment required depends on the desired quality of effluent.

(1) When turbidity is low, coagulation directly preceeds filtration.

(2) When turbidity is high, sedimentation follows coagulation and preceeds filtration, with coagulation and sedimentation taking place in open tanks rather than under pressure.

b. Operating difficulties are similar to those in gravity-type filters except that air binding seldom occurs.

c. Objections to the use of pressure filters for municipal supplies were set forth by Cox ("Water Supply Control," p. 66, 1942; N. Y. State Dept. of Health).

(1) Coagulation facilities are inadequate.

(2) Difficult to apply chemicals under pressure.

(3) Appearance of water being filtered and sand bed cannot be observed.

(4) Shape of filter makes it hard to provide wash water gutters that effectively remove all impurities during washing.

(5) Difficult to inspect, clean or replace sand, gravel or underdrains.

(6) Operation under pressure encourages filtering at excessively high rates.

E . . . Filter Aid Filters

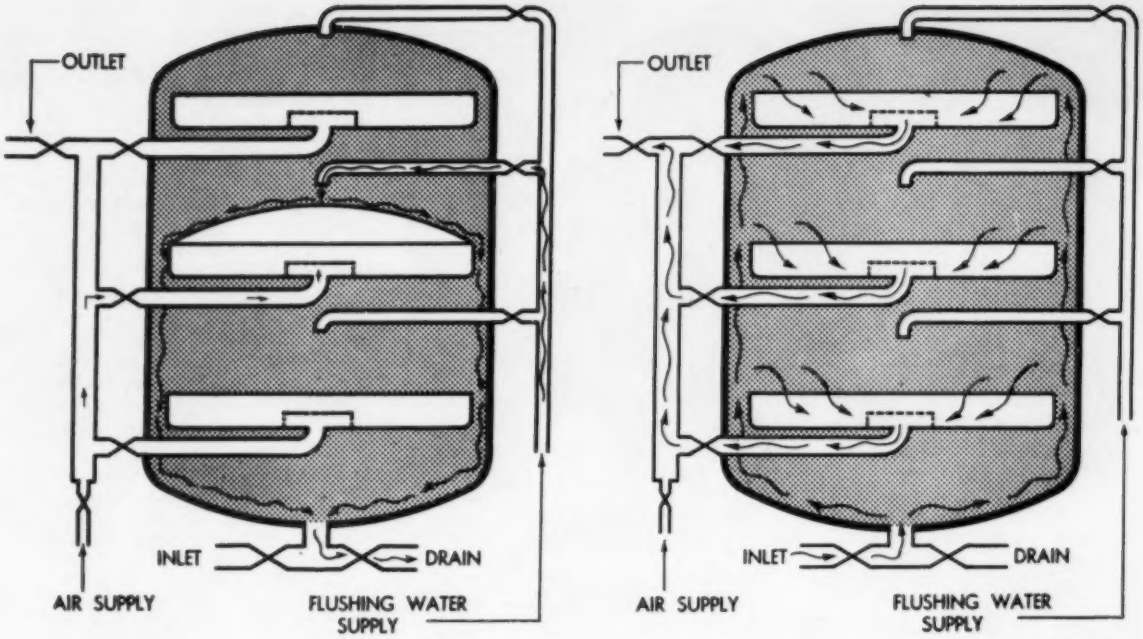
1 . . Design

a. Essentially a filter aid filter consists of a layer of finely divided particles deposited on a porous supporting membrane, which serves as an underdrain.

b. Most common filter aid material is diatomaceous earth.

(1) Hence the name diatomite filters (pronounced di-at'-oh-mite).

(2) Other filter aid materials include: Wollastonite, expanded perlite,



(Photo courtesy Infilco, Inc.)

Filtering Operation — DIAGRAM of SURFLEX diatomite filter — Cleaning Procedure

granular cellulose materials, asbestos fibre, activated carbon, etc.

c. Diatomaceous earth filters stem from the unglazed porcelain filters.

(1) Prior to World War II they were used to filter beer, wines, oils.

(2) During the war the filter aid filter was developed to a high degree for use in the field of operations; it was particularly effective in removing amoeba cysts as well as bacteria and turbidity.

d. The most common design is a pressure-type filter.

(1) It consists of a cylindrical shell divided into two compartments by a separator plate, or tube sheet, containing a number of holes.

(2) The filter elements, or septa, are porous cylindrical tubes, closed at one end and open at the other.

(3) The open end of the tubes is inserted in the separator facing upward and clamps or tie rods and bottom caps hold the tubes tightly against the holes in the separator plate.

(4) Flow direction is upward, the treated water entering the bottom compartment, the filtered water leaving the upper compartment.

(5) A 30-in. diameter shell can contain as many as fifty-five 2½-in. dia elements more than 4 ft long.

. . . The total filtering area is 156 sq ft.

(6) Another type of diatomite filter utilizes tray septa as shown in the accompanying figure.

e. Filter elements are available in several types.

(1) Wire or plastic cloth; round wire, wound in groves on a central core; trapezoidal, self-spacing, stainless steel ribbon, wound on edge on a perforated metal core; porous, sintered-aluminum oxide; heavy trapezoidal wire, wound and spot welded to a metal core; and porous, elastic plastic or rubber on heavy wire mesh core. Each has advantages and disadvantages.

(2) The ideal element is chemically inert and resistant to corrosion; rigid to prevent cracking of the filter cake; should back wash easily, cleanly, and with even distribution of backwash water; and should be capable of being cleaned without removal from the shell.

(3) Most common are the wire-wound and porous elements.

. . . Wire-wound elements are easily cleaned mechanically, but are expensive and corrode under chemical cleaning methods.

. . . Porous stone elements are fragile, harder to clean mechanically, but easily cleaned chemically.

f. A new type design is open to the atmosphere and operates under a slight vacuum.

(1) It has the advantage that operation can be observed.

(2) A high-pressure system is not required for operation.

(3) Development and use of this system may remove some of the objections to the pressure system which have been raised against the use of diatomite filters.

g. Capacities are limited by the filtering rate and size of the unit.

(1) For municipal water supplies the filtering rate is usually limited to 1 gpm per sq ft, although it may be twice that.

(2) In the 30-in. dia shell the capacity would be between 225,000 and 450,000 gal per day (1 to 2 gpm per sq ft.) Multiple units will provide the desired capacity of a plant.

2 . . Operation

a. *A "precoat" layer* of ditomaceous earth approximately 0.1-in. thick is deposited on the filter element at the start of each filter run and before the filter goes on the line.

(1) This precoat layer is held on the tube surface by the flow of water and slight differential pressure between the two compartments.

(2) This filter mat is similar to the schmutzdecke layer on a gravity filter.

b. *Filter aid particles* are microscopic and the openings between them in the mat are sub-microscopic; therefore, suspended and colloidal matter are strained out of the water.

c. *"Body feed"* is a procedure designed to avoid clogging of the filter mat and shortening of filter runs.

(1) A continuous addition of filter aid material is made to the water entering the filter.

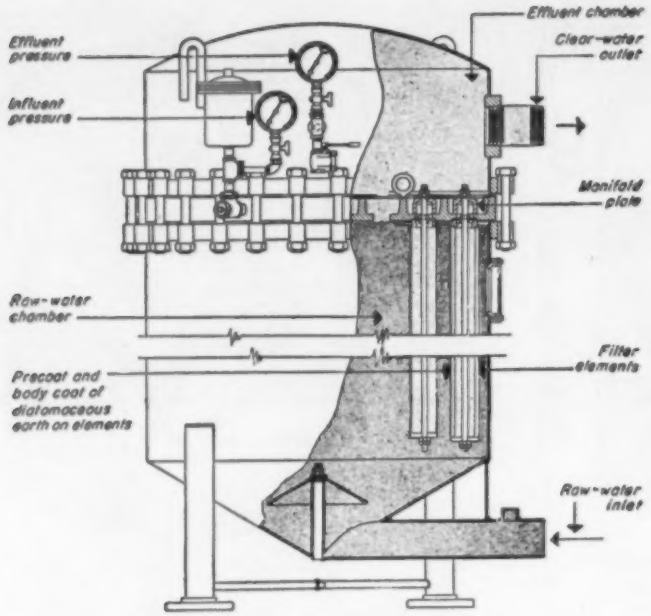


DIAGRAM of diatomite filter

. . . Body feedrates are proportional to flow rates.

(2) Body feed extends the filter runs by 1,000 per cent, because it continuously builds up the cake and separates foreign matter particles, thus prevents total clogging of the openings.

. . . Filter runs of 60 to 90 hours are possible. Length of filter run depends on turbidity in the raw water.

. . . Dosage of body feed is from 100 to 250 lb per mil gal; it is fed from a mixing tank containing a slurry and pumped by a positive displacement pump.

d. *Chemical treatment* consists of hypochlorination or chlorination; coagulation and sedimentation may be used in very turbid waters.

e. *Backwashing* to remove the filter cake is accomplished by reversing the flow through the filter, in a special manner.

(1) At the end of a filter run, as determined by decreased flow or arbitrary limit of pressure loss, the effluent line is closed.

. . . Since an air chamber exists in the top of the effluent section, pressure is built up as the air compresses.

(2) The influent valve is then closed and a quick opening backwash drain valve opened.

. . . Pressure in the influent chamber decreases suddenly to zero.

. . . The compressed air in the effluent chamber expands suddenly, driving water back through the filter element with explosive violence (at a rate of several hundred gal per min per sq ft.)

. . . This backwash blasts the cake from the filter surface, leaving it clean.

(3) An air vent in top of the filter is then opened and the filter rinsed and drained.

(4) The time of washing is but a few minutes and the amount of wash water used is equivalent to only a few minutes' production of the filter, that is less than 0.5 per cent of the water filtered between washings.

f. *Operating problems* consist of two types.

(1) Misapplication of the equipment.

(2) Chemical difficulties.

. . . Carrying-over of floc.

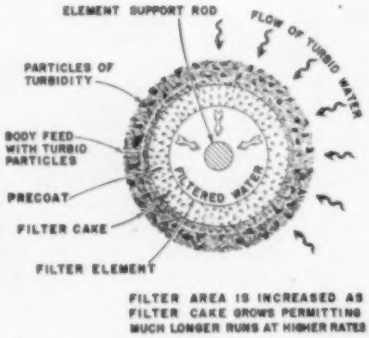

ELEMENT SUPPORT ROD
FLOW OF TURBID WATER
PARTICLES OF TURBIDITY
BODY FEED WITH TURBID PARTICLES
FILTERED WATER
PRECOAT
FILTER CAKE
FILTER ELEMENT
FILTER AREA IS INCREASED AS FILTER CAKE GROWS PERMITTING MUCH LONGER RUNS AT HIGHER RATES

DIAGRAM of filter element, precoat, and filter mat

. . . Iron and manganese plating out on the filter element. This difficulty requires chemical washing.

. . . Corrosion, particularly of metal filter elements.

3 . . Results

a. Diatomite filters may be expected to produce an effluent with a turbidity of less than 0.2 ppm.

(1) Maximum practical loading in the raw water is 100 ppm of turbidity.

. . . Filter runs of 18 hours have reported for this loading.

(2) The lower the turbidity in the raw water, the longer the filter run.

b. Bacterial reductions are excellent; cysts and algae are removed.

c. Removal of color, tastes and odors is not effected.

d. Cost of operation is from $0.03 to $0.05 per 1,000 gal.

F . . . Miscellaneous Filters

1 . . Automatic Backwash

a. A rapid sand filter consisting of a compartmented sand bed with underdrains, and a backwash and cleaning mechanism which travels on tracks on the side walls of the tank.

b. Each compartment connects with a separate effluent and backwash port.

c. The traveling cleaner starts automatically when the head loss on the filter exceeds a preselected value.

d. The cleaner has two pumps, one discharges filter effluent back through the sand, the other removes the dirty water from the top of the compartment.

2 . . Multiple Filters

a. Multiple filters consist of two filters operating in sequence at different rates.

b. One arrangement is a roughing filter or "scrubber" of coarse sand operating at a high rate ahead of a slow sand filter.

c. Another arrangement consists of a regular rapid sand filter followed by a slow sand filter to "polish" the effluent.

d. The idea of multiple filtration was proposed by Porzio in 1685. He described the system as "an imitation of Nature's method of passing water through the 'Bowels of the Earth', producing . . . 'Fountains whose waters are good and salutary' ".

e. The Peuch-Chabal system of a roughing filter, prefilter and filter was used in a number of places in France in the late 19th Century.

f. Modern practices utilizes double filtration only "as a matter of economy in construction or operation or to utilize existing structures," accord-

ing to the AWWA Manual of Water Quality and Treatment.

3 . . Drifting Sand Filters

a. In principle, sand is taken from the bottom of the filter, washed and distributed over the surface of the bed.

b. Several designs and patents were developed from 1883 to 1930. The oldest was a Hyatt filter in the United States, the latest a French design.

c. Only plant of appreciable size and recent vintage in America is the Ransome drifting sand filter in Toronto, Can.

(1) The plant went into operation in 1918 with a capacity of 72 mgd. It supplemented slow sand filters.

(2) In 1941 modern rapid sand filters were built to meet ever-growing demand, thus giving Toronto three types of filter plants.

4 . . Upflow Filters

a. Peacock (London, 1791) proposed a filter of graded spheres with the larger at the bottom and upward flow for filtering and downward flow for washing.

b. The Porzio multiple filter idea in 1685 was for a combination of upward and downward filters.

c. Four American patents were granted for upflow filters in the last half of the 19th Century.

(1) Flad, Cook, Hyatt, and Sellers.

(2) First American installation was in 1832 at Richmond, Va., where the system failed immediately.

(3) New Milford, Conn., tried the plan in 1874; perhaps ten other installations were made prior to 1894.

. . . None of them lasted very long.

. . . A British patented upflow filter was introduced in 1920 and installed at two municipal plants and several industrial plants.

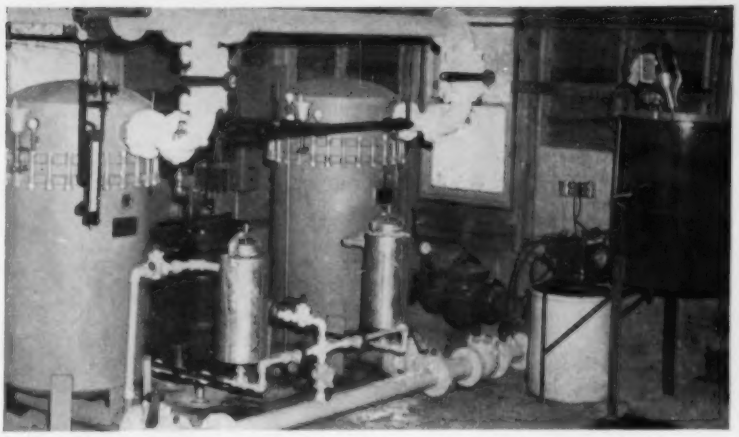
5 . . Natural Filters

a. Natural filters utilize the filtering action of sands and gravel beds. Most common are infiltration galleries.

(1) Stone (ASCE Proc., *80*, Sep. 472; 1954) describes infiltration galleries as "horizontal-type permeable conduits that intercept and collect ground water by gravity flow for a water supply source."

(2) Earliest infiltration galleries were in ancient Persia. Modern use of infiltration galleries stems from European practice in the early 19th Century.

(3) Many have been used in this country since the idea was introduced by Kirkwood in 1866 in a treatise of his European observations.



TEMPORARY INSTALLATION of diatomite filters on surface supply where well supply failed

b. Stone lists three limitations to infiltration galleries.

(1) A shallow aquifier is required for low construction costs.

(2) Plentiful recharge of ground water must be available to maintain high production rate. There are three sources of recharge:

. . . Direct spreading of imported water into pervious surface spreading basins.

. . . Recharge of a granular stratum underlying a body of water. This method has led to the construction of infiltration galleries paralleling the shore of bodies of surface water.

. . . Large artesian aquifer continuously supplied from distant sources .

(3) Quality of water.

. . . Ordinarily only localized pollution would be expected to affect adversely the physical and chemical quality of water.

c. Interest in natural filtration has grown with the development of water spreading for the recharge of ground water aquifers.

(1) California studies (Stone and Garber, ASCE Trans., Paper No. 2530; 1952) showed that "clear potable effluent can be produced from partially treated sewage discharged into spreading basins and infiltrated through 3 to 7 feet depth of soil."

(2) Greenberg and Gotaas (Am. Jour. Pub. Health, *42*, 401; 1952) showed that water meeting drinking water standards was obtained after polluted water infiltrated through soil.

(3) At Peoria, Ill., the Illinois State Water Survey showed that polluted Illinois River water could be pumped into abandoned gravel pits to restore the ground water aquifer in that area.

d. According to Stone, filter galleries may be expected to supply 1 mgd per each 1,000 ft of length.

(1) Permeability and recharge factors affect the rate.

(2) Except for fissured rocks, the maximum dependable yield for most sand and gravel aquifers is less than theoretical.

(3) Filter galleries can be used in shallow aquifers to prevent salt water intrusion.

e. Stone's paper (ASCE Proc., *80*, Sep. 472; 1954) contains other pertinent information on advantages, experiences, types of interceptors, depth of aquifers, construction details, formula for estimating yield, and reasons for failures.

f. A modern counterpart of the filter gallery is the Ranney well system (or water mine) when installed alongside of a watercourse or in the bed of a river.

G . . . References

Material for this lecture was obtained from the following reference texts, in addition to references cited:

AWA—"Manual of Water Quality and Treatment," 2nd Ed., Chap. 11.

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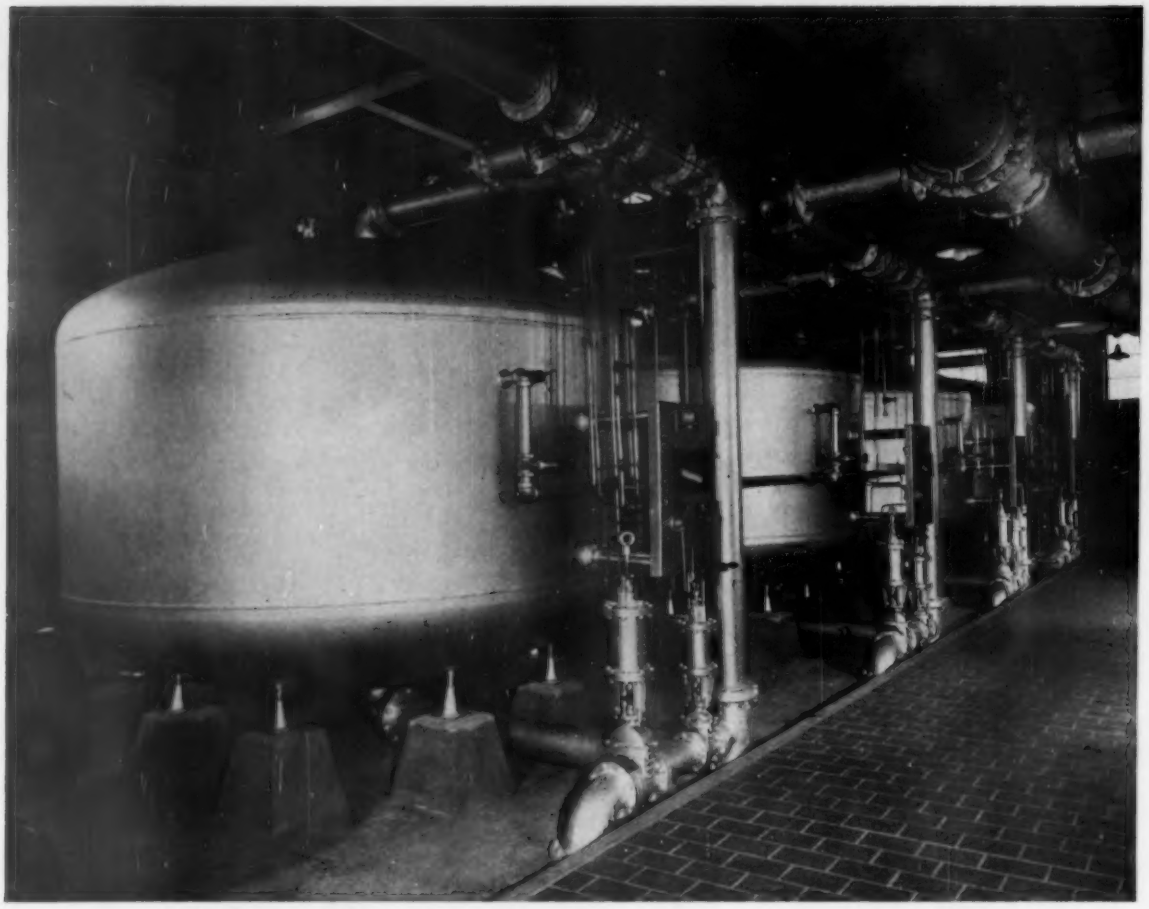
Buswell—"The Chemistry of Water and Sewage Treatment," A.C.S. Monograph No. 38 (Chem. Cat. Co.)

Fair and Geyer—"Water Supply and Waste-Water Disposal" (John Wiley & Sons).

Hardenbergh—"Water Supply and Purification" (Int. Textbook Co.).

Steel—"Water Supply and Sewerage," 3rd Ed. (McGraw-Hill).

Next Lecture—Taste and Odor Control.



ONE SIDE of pressure filter installation for iron and manganese removal at Jamaica Water Supply Co.

Iron and Manganese Removal

by S. B. APPLEBAUM

Mr. Applebaum is Director, Water Treatment Division, Cochrane Corporation, Philadelphia, Pa. **In this paper* he discusses the differences of opinion that arise in specific problems of iron and manganese removal from water and means of resolving them by pilot plant testing.**

THE TECHNICAL LITERATURE on water treatment contains many articles on iron and manganese removal. The subject is about 100 years old. Yet despite its antiquity there has been evidence, even of late, of differences of opinion when those skilled in the art are confronted with a specific iron and manganese removal problem. It is, therefore, the purpose of this paper mainly to explore these differences and to show how they may be resolved by pilot plant testing, using as an example the case of a large iron and manganese removal plant at Jamaica, N.Y.

Well waters are often preferred to surface supplies because of their greater clarity and lower temperatures. However, when the well water contains more than about 0.2 to 0.3 ppm of iron plus manganese, these impurities come out of solution in the

* Presented at the 1955 Annual Water Conference, Engineers Society of Western Pennsylvania, Pittsburgh, Pa.

form of brownish to purple colored precipitates, which cause many troubles to industrial and household users.

These troubles may be briefly summarized as follows:

1. An astringent metallic taste is imparted to the water.
2. In industry, discoloration of paper, textiles, ice, leather and all the other wet processed manufactured products takes place.
3. In the household, stains form on porcelain basins, bathtubs, glassware and dishes, as well as the laundry wash.
4. For cooling water, not only do the precipitates clog piping, but the iron stimulates the growth of certain plankton such as *Crenothrix*, which form slimly stringy deposits in the cooling towers, piping and heat exchangers.
5. Today, in the rapidly growing field of demineralization for high-pressure boiler plants, iron and manganese foul the ion exchange resin, so that their removal in pretreatment plants is essential to protect the high investments in these plants.

Chemistry of Treatment

In general, there are two main forms of treatment, as follows:

1. Those involving oxidation reactions:
   (a) Aeration, with or without settling and finally followed by sand filtration.
   (b) Filtration through manganese zeolite.
2. Ion exchange without oxidation, combining water softening with the iron removal.

The chemical reactions are given in Table 1.

In the usual oxidation reaction accomplished by aeration (in the case of iron as given in Eq. 1), the ferrous bicarbonate, which is the prevailing form present in well water, is oxidized by the oxygen added to form ferric hydroxide precipitate and free carbon dioxide is liberated.

In the case of the manganese zeolite, which, in fact, was developed about 50 years ago[1] in Germany to cope with high manganese rather than iron, it is produced in the following manner:

Sodium zeolite is first treated with manganous chloride or sulfate to convert it to manganous zeolite (see Eq. 2). Then it is treated with potassium permanganate to form manganic oxides in the zeolite (see Eq. 3). These higher oxides give up oxygen gradually as required to oxidize the manganese in the water which is filtered out by the zeolite bed (see Eq. 4). Periodically the bed must be re-oxidized or regenerated by permanganate or other oxidizing reagents to restore the higher active manganic oxides. These regenerations are obviously expensive.

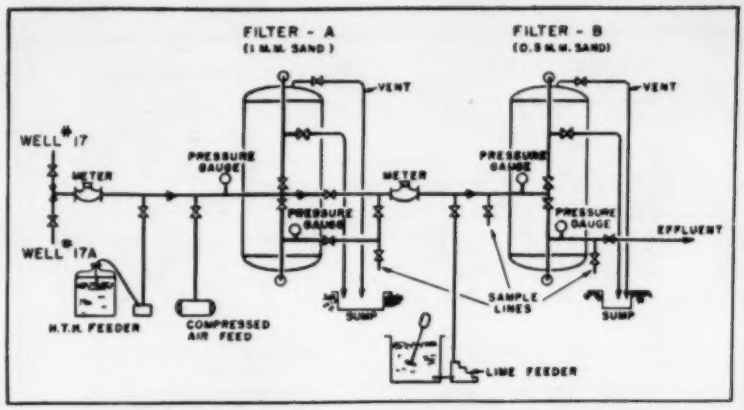


Fig. 1—PILOT PLANT flow diagram, showing connections of chemical feeders and controls.

If the water contains much more iron than manganese it is desirable as well as economical to remove the iron first by aeration and sand filtration, leaving the more difficult manganese removal to be accomplished by the manganese zeolite. This is not only true for manganese zeolite, but Wieters[2] also recommended it as well for sand filter plants.

The non-oxidizing ion exchange reactions merely involve exchanging ferrous iron and manganous manganese in the water for the sodium of sodium zeolite simultaneous with the usual water softening (see Eq. 5). In fact, the iron and manganese continue to be removed even after the hardness begins to break through. This process has been used successfully for fairly soft waters, even containing over 50 ppm of iron.

The only precaution necessary is that no dissolved oxygen enters the water before the zeolite bed. Even if some dissolved oxygen is sucked in at the suction of the well pump, it causes ferric hydroxide precipitates to foul the zeolite and this stops the ion exchange reactions.

This method has found application in many municipal and industrial plants when water softening is desired at the same time as iron removal. However, where iron and manganese removal alone without softening is desired (as was the case at Jamaica, N.Y.) only the oxidation methods are considered.

Factors Influencing the Oxidation Reaction

The speed of the oxidation reaction determines the complexity and, therefore, the first cost of the iron removal equipment required in any given case.

TABLE 1

Chemical Reactions in Iron and Manganese Removal

Reaction	Equation	Eq. No.
Oxidation*	$4\,Fe(HCO_3) + O_2 + 2H_2O \rightarrow 4\,Fe(OH)_3 + 8CO_2$	1
Preparation of manganese zeolite	$Na_2O.Z + MnCl_2 \rightarrow MnO.Z + 2NaCl$	2
	$MnO.Z + 2KMnO_4 \rightarrow K_2O.Z \cdot MnO.Mn_2O_7$	3
With manganese zeolite†	$K_2O.Z \cdot MnO.Mn_2O_7 + 2Mn(HCO_3)_2 \rightarrow$ $K_2O.Z \cdot 5MnO_2 + 4CO_2 + 2H_2O$	4
Ion exchange without oxidation	$Na_2Z + \begin{matrix}(Ca)\\(Mg)\\(Fe)\\(Mn)\end{matrix} \cdot (HCO_3)_2 \rightarrow \begin{matrix}(Ca)\\(Mg)\\(Fe)\\(Mn)\end{matrix} Z + 2NaHCO_3$	

*Using ferrous bicarbonate as the example.
†Using manganese bicarbonate as the example.

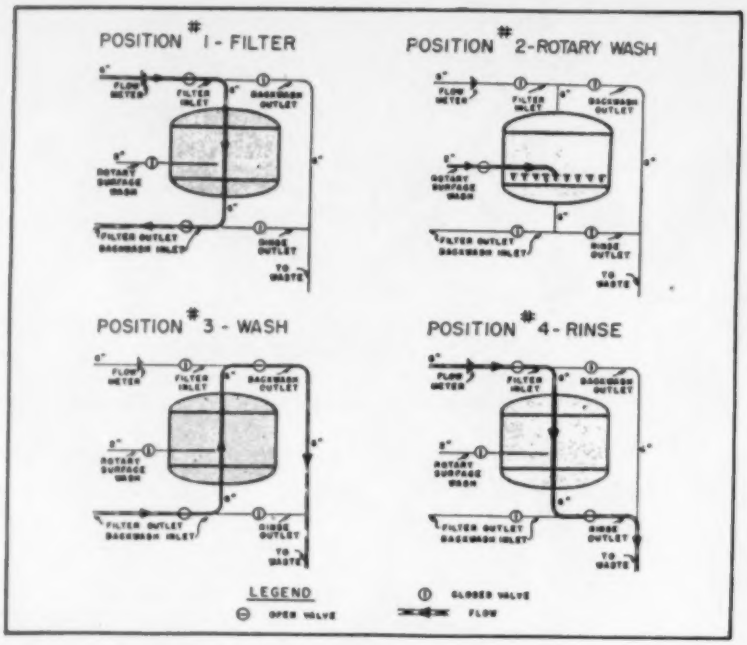


Fig. 2—OPERATING CYCLE of wash, rinse and filter

This speed is influenced by a number of factors which should be briefly discussed, as follows:

1. Well waters containing high alkalinity and high total dissolved solids are rapidly oxidized. Such waters, as in the case of Mid-Western wells, when freshly drawn from the well pump show rapid formation of first a milkiness and then soon thereafter the usual yellow to brown iron hydroxide precipitates. However, along the Eastern seaboard wells are, as a rule, lower in alkalinity and total solids and the oxidation reaction is much slower.

2. pH value is important. Iron hydroxide precipitates are most rapidly and completely formed at a pH range of 7.0 to 9.0. Manganese, on the other hand, calls for a higher optimum pH of 8.5 to 10.0. Therefore, if the well water has too low a pH value the addition of lime or soda ash is required.

If the well water contains high free CO_2 which depresses the pH value, the use of atmospheric open aerators or closed forced draft aerators is indicated to remove some of this CO_2 first to save some of the alkali later added.

3. Organic matter present, as in the case of well waters in swampy regions, inhibits and slows down the oxidation reactions. Such organic matter must then be removed by prechlorination.

Contact Filters or Solids Contact Reactors Preceding Final Filters

Where inhibiting factors are present or when the amount of iron and manganese present is relatively high, the use of single filtration alone would result in high pressure losses and too frequent backwashing. In such cases the use of contact filters or solids contact reactors is indicated. These remove part of the iron and then the final filters finish the removal.

Contact filters employ coarser filter particles than the final filters. There is, therefore, more space between the particles for the storage of precipitates without causing such rapid build-up of pressure losses. Also, the precipitates in the contact filters act as catalytic agents to speed up the oxidation of the iron and manganese.

Various materials are employed in the contact filter beds such as pyrolusite[3], coke, lava[4], calcite, and (mainly) gravel or coarse sand.

Settling basins, or preferably solids contact reactors, are justified if the amounts of iron and manganese are so high that even the contact filters would be overloaded and cause too high a head loss and too frequent backwashing.

Moore, at Harvard University, made some research studies[5] with a solids-contact laboratory unit proving the efficacy of synthetically prepared sludge for this purpose.

However, contact filters have two advantages over settling tanks as follows:

1. Lower initial cost.

2. Contact filters can be made in the form of pressure units so that repumping is avoided.

With this brief review of the factors influencing the design of iron and manganese removal plants in general, we may now proceed to a discussion of the Jamaica case.

Jamaica, Long Island

As Hobson and Ley pointed out in 1950[6], the Jamaica Water Supply Company draws its supply from a number of wells then delivering about 67 mgd.

These wells were not all located at one spot, but were dispersed to obtain maximum yield as well as to facilitate their most economical connection to the distribution system.

The well waters proved an economical and suitable water supply in most respects. The hardness was not excessive, so that water softening was not compulsory for this municipal application. However, iron and manganese were present in excessive amounts in some of the wells, causing complaints by the consumers. Therefore, a number of water treatment plants were found necessary. In the past different types of equipment were

TABLE 2

Summary of Bids on Iron and Manganese Removal at Jamaica, N. Y.

Bidder	Type of Equipment	Bid,* $
A	Manganese zeolite pressure filters (4.5 gpm per sq ft rate), also lime feed (20 psi loss of head)	78,700
B	Double-deck lava and sand filters (4.5 gpm per sq ft rate), also soda ash feed, compressors for 134 cfm	139,000
C	Open aerator, gravity filters, lime feed, and high-service pumps ($6,000). To this must be added the estimated value of concrete containers ($50,000)	111,000
D	Single pressure filtration (5 gpm per sq ft rate)	46,800
D_1	Single pressure filtration (4 gpm per sq ft rate)	65,650

*1949 bid; increased by 10 per cent escalator (where necessary) to put all bids on the same firm basis.

installed at two of the stations:

1. At Station 6, a 5-mgd plant consisted of a gravity plant with open atmospheric aeration, chlorination, settling and filtration through gravity filters containing a 27-inch deep sand bed. This involved a secondary high-lift pumping station after the water treatment plant.

2. At Station 18, a 2-mgd plant consisted of a pressure plant without repumping, but the individual filters were combination units containing a contact roughing filter of coarse lava in an upper deck and a final finishing filter containing a mixture of sand and calcite in the lower deck. This plant was described by Ley in a previous article[4]. Compressed air was distributed continuously through a perforated pipe system inside each unit just below the lava contact filter deck, bubbling up through it counterflow to the water.

The new project, for which this third iron and manganese removal plant was to be built had four wells some distance apart. However, instead of building separate plants at each well it was decided to install a central plant of 5-mgd capacity to treat the combined output of the wells.

The combined raw water was clear and colorless, but had the following average chemical analysis:

Constituent	*Conc., ppm*
Total hardness (as $CaCO_3$)	118
M.O. alkalinity (as $CaCO_3$)	82
Free CO_2 (as CO_2)	18
Chloride (as Cl)	11.8
Iron (as Fe)	0.64
Manganese (as Mn)	0.22

A specification was written inviting bids on iron and manganese removal equipment for 5-mgd capacity to reduce the sum of the Fe and Mn from 0.86 ppm to under 0.2 ppm. Preference was expressed for pressure units to avoid repumping, and losing not only 10 psi pressure with only one backwashing daily, but alternate proposals were allowed if other types were justified.

When this specification was received the author's company felt that single filtration would suffice. However, it was decided that it might be advisable to investigate and prove that the desired results could be obtained by such a simple type of single filtration preceded by pressure aeration, injecting small quantities of chlorine and compressed air directly to the common inlet together with injection of lime under pressure if pH adjustment was needed. Such an investigation seemed all the more necessary in this case because of the fact that previous designers had apparently found that the more elaborate types of treating equipment described had been justified for other wells in Jamaica.

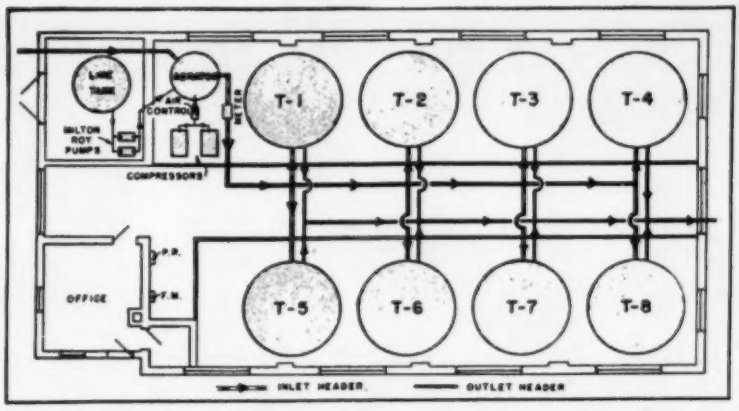


Fig. 3—NORMAL FLOW through the eight pressure filters comprising the iron and manganese removal plant serving five wells of the Jamaica Water Supply Company

Therefore, it was decided to install a pilot plant at the site consisting of two 12-inch diameter pressure filters to act in series, one with 1.0-mm effective size coarse sand to act as a roughing contact filter and the other with 0.5-mm finer sand to act as a final filter. In addition, a hypochlorite feeder to inject Cl, a lime feed, and an air compressor and receiver were included. Thus there was available all the equipment needed to answer the following questions:

1. Is contact filtration ahead of final filtration necessary, as was previously installed at Station 18?

2. If single filtration suffices what rates of flow in gpm per sq ft of filter area would give the desired results with no more than 10 psi loss of pressure in 24 hours?

3. Is chlorine addition, plus lime addition for increase in pH value, necessary for iron and particularly manganese removal, and if so what pH values are optimum?

Fig. 1 shows the pilot plant set-up. The results obtained may be summarized as follows:

1. Single filtration through a 15-inch depth of 0.5-mm sand at a rate of 5 gpm per sq ft gave the desired results and within the desired loss-of-head limit.

2. Prechlorination was helpful but not essential.

3. Injection of air was necessary if prechlorination was not used.

4. Addition of lime and increase of pH above 7.1 was not needed for reduction of iron to less than 0.03 ppm, but increase of pH value to about 8.3 was required for reduction of manganese to figures as low as 0.02 ppm.

When bids were received it was found that there were four bidders, each of which bid on a different type of treatment plant. These bids, for the equipment not erected, are summarized in Table 2.

The award was made to Cochrane Corporation on bid D_1. The decision to use the 4-gpm per sq ft rate was based on the desire to have a greater factor of safety in avoiding excessive pressure losses.

The plant finally installed consisted of the following units:

1. 8 pressure filters, 12 ft in diameter by 5 ft high with 15-inch depth of 0.55-mm (effective size) sand resting on several layers of different sizes of gravel of 20-inch total depth.

2. Rotary surface washers.

3. Lime tank 9 ft in diameter by 5 ft high and two volumetric reciprocating pumps for lime injection.

4. A pressure aerator 5 ft in diameter by 6 ft high with two air compressor and receiver sets. This was enough for injection of the small amount of air (24 cfm each) into the common inlet to oxidize the iron and manganese. Controls consisted of Fischer & Porter Flowrator and Moore differential flow controller.

5. Filter valves consisting of hydraulic cylinder-operated gate valves controlled manually by a pilot disc valve on each unit, which had the four operating positions marked on it. The operator turns this pilot valve by a small hand lever to the four positions, one after the other, and the pilot valve opens and closes the correct large gate valves in the right order automatically. Fig. 2 shows these four positions.

6. Individual unit Bailey rate-of-flow meters with flow nozzles, pres-

sure gauges and a backwash rate of flow meter. These constituted the instrumentation. Fig. 3 shows a plan of the entire plant. The photo shows a battery of four filters on one side of the aisle.

Results Since 1950

The plant was started in January 1950. In the period from then until August 30, 1955, the following operating results were obtained[7]:

1. 8,925 mg of water were treated.

2. Another well was added and the plant is now operating at a 3,200-gpm average and 4,500-gpm maximum. The latter is 6.5 mgd, or a rate of 5.0 gpm per sq ft instead of the initial rate of 4 gpm per sq ft based on 5.2 mgd (3,600 gpm).

3. The usual treatment consists of adding about 10.5 ppm of lime to maintain a pH of 7.5.

4. The iron and manganese in the combined raw water varies with the wells used. The following gives the maximum in the incoming influent and the usual iron and manganese in the effluent. Some of the five wells have over 1 ppm present, but they are diluted to about one half this value by the other wells.

	Combined Raw Water	*Effluent*
Iron, ppm as Fe	0.74	0.02
Manganese, ppm as Mn	0.23	0.03
Total	0.97	0.05

5. Backwashing is required about once in 32 hours for each unit and the loss of head at the end of the run is about the same as in 1950, when the plant started, or 7 psi.

6. Air is added continuously.

7. Chlorine is added continuously into only one of the five wells to oxidize some odorous organic matter present. Then a little ammonium chloride (5 lb per day) is mixed and added with the lime. Therefore, only a chloramine residual of about 0.2 ppm is present in the combined filter influent.

8. There has been no loss of sand.

9. The pilot disc valves have been re-ground occasionally.

10. Some fine sand from one of the wells collected in one of the units nearest to the common inlet. This caused the filter bed to grow so that the rotary surface wash stopped. The loss of head through this unit also increased. The fine sand was then scraped off and the unit returned to normal.

11. The backwash procedure consists of (a) rotary surface wash for 1 minute, (b) backwash at 1,500 gpm for 10 minutes, and (c) filter to waste at 500 gpm for 5 minutes. The total waste water amounts to about 2.5 per cent of the total water treated.

12. The total erected cost was $170,700, or $34,138 per mg, including structure, electrical, plumbing and heating, foundations, labor of erecting equipment, and connection of piping to the distribution system. The operating cost is:

Electrical energy for pumping from ground to service	$24.67
Treatment	2.19
Operating labor	4.28
Total, per million gallons	$31.14

Conclusions

This case history indicates that even today there is considerable difference of opinion when experienced bidders are invited to bid on equipment to solve a specific iron and manganese removal problem.

In fact, the differences of opinion in this case resulted in a range of first cost for equipment alone from $50,000 to $139,000.

The erected costs would be still farther apart because the more complicated types of equipment, such as the gravity filters, etc., would cost more to erect. Therefore, it is conservative to estimate that the saving to the user in this case amounted to more than $100,000 in total investment, as well as an appreciable saving in operating cost, by adopting the design installed.

In passing, it is of interest to report that in Station 18, where the double-deck contact lava beds over the final sand calcite beds were originally used, it was found possible to remove the lava from the upper decks without affecting the results. Such contact filters are no doubt valuable for high iron bearing waters, especially with high organic inhibitants present. Nevertheless, at Station 18, with the present well water, and at this later plant previously described, contact filtration or sedimentation preceding the single filtration was not required.

The pilot plant tests were very valuable in determining the allowable rates per square foot, which determined in great part the required investment. There is no substitute for such pilot plant testing, not only in iron removal problems but also in many of the related water treatment fields.

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Community—Industry Cooperative Waste Disposal Project Sets a Pattern

What is believed to be the largest community-industry cooperation waste disposal project on record is that of the Carbide and Carbon Chemicals Corp. and the City of South Charleston, W. Va. It bids fair to become a pattern setting project in the cooperative financing, construction and operation of a pollution abatement undertaking.

To build a joint sewage and industrial water treatment plant by 1958, Carbide and Carbon will furnish the engineering at cost. In addition, the Carbide Corporation will pay its share of construction and all other costs plus one half of the City's share of the costs.

After the plant is completed an operating company is to be established, known as the South Charleston Sewage Treatment Co. This is to be a wholly owned subsidiary of Carbide and Carbon which will operate and maintain the treatment plant at cost. The plant may also treat wastes from other industrial plants in South Charleston.

Here it is—just as predicted for sometime by this publication and its editor. Just the reverse of a municipality treating sewage plus industrial wastes, this is a case of an industry treating municipal sewage in industry's treatment plant, and the municipality paying its fair (and minor) share of the costs. In view of the fact that the industrial waste is the major pollution and the municipal sewage the relatively minor pollution in the South Charleston situation, the type of cooperative solution in this case looks to be the most realistic solution. There are a number of "South Charlestons" in the country and we see here a definite pollution abatement pattern established. Compared with treatment of the industry's waste the treatment of the community sewage is just "peanuts".

PORTABLE CHLORINATOR set-up for disinfection and Crenothrix removal from distribution system of Oxford, N. Y.

Disinfection of the Oxford Water System

Proves effective in clearing mains of Crenothrix

by A. G. WHELER and H. C. SMITH

Mr. Wheler is Associate Engineer with the firm of Donald E. Stearns, Civil and Sanitary Engineers, Cazenovia, N. Y.

Mr. Smith is District Manager, Fischer & Porter Company, Albany-Syracuse, N. Y.

COMPLAINTS of red water, tastes and odors plagued the village officials from the portion of Oxford, N. Y., on the easterly side of the Chenango River. Such complaints were never received from the major portion of the town on the westerly side of the river. In the course of discussions with village officials these facts were revealed to senior author's firm, which had been retained to recommend improvements to the water system designed to furnish an additional source of supply and to improve fire flows.

The main water supply of the village is from gravity springs located some four miles north of the village, which feed three reservoirs on the hills to the west of Oxford. Water is fed into the distribution system from both the reservoirs and the springs. An 8-inch main under the Chenango River, and a 6-inch main across the river bridge, supply the easterly area of Oxford. An additional well supply, which supplies about 30 gpm, feeds into the easterly side of the distribution system. Chlorination of the supply has not been practiced because the source of supply is uncontaminated ground water.

Analyses of the spring and well supply revealed that the well supply contains considerable iron, whereas the spring supply has none. Examination of samples from complaining consumers' premises indicated the presence of the "iron bacteria," *Crenothrix*.

The consulting engineers suggested that the easterly section of the distribution system be disinfected to remedy the *Crenothrix* problem before the proposed improvements to the water system were undertaken. The village officials felt that such a program was an excellent idea.

The consultants called in a representative of Fischer & Porter Company, who said that his company would assist by making available a portable chlorinator and a field engineer, without charge to the village, as a service.

The Disinfection Project

The disinfection program was planned as follows: A detailed notice of the disinfection was published in the newspapers. A post card was sent to each water customer on the east side, outlining the hours of the disinfection and referring them to the de-

tailed newspaper discussion. In addition to these precautions, the Central School, also on the east side, was closed for the day.

The pressure in the mains of the Oxford distribution system is ordinarily about 95 psi. In order to inject a chlorine solution, this pressure was reduced by closing the gate valves in the two lines crossing the Chenango River, thus removing the pressure of the reservoirs which float on the system. The 30-gpm pump on the east side also was shut off.

For the chlorinator water supply a 2½-inch fire hose was connected to a pressurized hydrant on the west side, strung across the highway bridge over the river, and connected to the ejector water supply of the portable chlorina- from the chlorinator was connected to an unpressurized hydrant through a short length of 1½-inch rubber hose. Chlorine was fed to the chlorinator through a manifold from six 150-lb cylinders.

Fire hydrants at the north and south ends of the eastern distribution system were opened to provide flow and other hydrants were intermittently opened and closed to enhance circulation, especially in the area of most frequent complaints. Additional forced circulation was obtained by throttling or closing various strategically located gate valves to insure that every section of the distribution system was chlorinated.

The system was superchlorinated in this fashion for a period of approximately seven hours at a chlorine dosage rate of 1,000 pounds per day, as set on the chlorinator. Every hydrant in the eastern system was then opened and flowed until a blood-red orthotolidine test was obtained, indicating high chlorine residual. After this the chlorinator and hydrants were shut off and three hours of contact between the chlorinated water and mains ensued. At the end of this time the gate valves between the west and east sides of the system were re-opened and the 30-gpm pump was started.

The whole eastern system was then flushed thoroughly through hydrant drafts for 1½ hours and it was noted that quantities of reddish water and other material was discharged from the hydrants. Because the flushing occurred from 12:30 PM to 2:00 AM it was difficult to determine, with only street lights, the exact nature of the residue that was flushed out of the system.

Since this disinfection program, the easterly side of Oxford has been free from complaints of red water, tastes and odors. The bitterest complainers, prior to the disinfection, called up the mayor to tell him how pleased they were with the results. Many said that the water was not only free from red color, taste, and odors, but that their flows and pressures seemed better.

The water works improvements scheduled to be installed consist of: (a) a new iron-free source of supply on the easterly side of the village; (b) a steel storage tank floating on the distribution system, to be located east of the village; (c) main strengthenings to insure adequate fire flows in all parts of the village; and (d) chlorination to prevent bacterial growths in the mains. The present well supply in the easterly section of the village would be put on standby service for emergencies.

Water Superintendent Bartlett and his men were of great assistance during the disinfection program. Mayor R. F. Seymour and the Village Board deserve high praise for their efforts toward modernizing the Oxford water distribution system and providing additional water supply for the community.

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Hess Recipient of Schoellkopf Medal

The 1956 Jacob F. Schoellkopf medal of the Western New York Section of the American Chemical Society has been awarded to Raymond W. Hess, Coordinator of Pollution Research for National Aniline Division, Allied Chemical and Dye Corporation, "for outstanding contributions to the solution of the chemical, social and economical problems associated with control of pollution and for devoted service to the Western New York Section as officer, committeeman and historian".

Dr. Hess was born in Plover, Iowa. He received an A.B. and A.M. Degree from Morningside College followed by a Ph.D. in chemistry from the University of Illinois in 1916. While in graduate school, he was elected to Phi Lambda Upsilon and Sigma Xi.

He is a member of the Buffalo Chamber of Commerce, The Buffalo Torch Club, and a lifetime director of the Illini Club of Western New York.

Dr. Hess has been a member of the American Chemical Society since 1913, and has been an integral part of the activities of the Western New York Section since 1922. He was Section Chairman in 1926-27, Honorary Chairman of the Section's Golden Anniversary in 1955, as well as being the leading figure in the publication of the Section's Fifty Year History.

Dr. Hess is a member of the Manufacturing Chemists' Ass'n., Inc's. Water Pollution Abatement Committee and Chairman of its Subcommittee on Public Relations and Water Quality Standards. Also, he is chairman of the Subcommittee on Research Projects of the National Technical Task Committee on Industrial Wastes.

He is also: Chairman of the Industrial Wastes Committee and member of the Publication Committee of the Federation of Sewage and Industrial Wastes Association; Member of the Subcommittee on Detergent Wastes of the Chemical Industrial Advisory Committee to the Ohio River Valley Water Sanitation Commission; Member of the Detergent Wastes Committee on Analysis, Association of the American Soap and Glycerine Producers, Inc.; Chairman of the Water and Air Pollution Committees, Associated Industries of New York State, Inc.; Member of the New York State Water Pollution Control Board's Technical Committee; Chairman of the Industrial Wastes Committee, New York Sewage and Industrial Wastes Association; Assistant Co-Chairman, 1956 Meeting, Air Pollution Control Association; and Coordinator of the Tariff Task Force in Intermediates, Synthetic Organic Chemical Manufacturers Association.

Dr. Hess is a Fellow in the American Association for the Advancement of Science, a member of the American Institute of Chemical Engineers, the New York Sewage and Industrial Waste Association, the Professional Chemical Society, Alpha Chi Sigma, Phi Lambda Upsilon and Sigma Xi.

Relay Test for Motor Protection At Sewage Pumping Stations

How the Hampton Roads Sanitation District Commission saves vital equipment through preventive maintenance tests

by R. C. THAYER and J. E. SMITH
Mr. Thayer is Mechanical Engineer and Mr. Smith is Electrical Superintendent for the Hampton Roads Sanitation District Commission, Norfolk, Va.

IN THEORY, motors are safeguarded from overcurrent damage when there is a properly rated and accurately calibrated motor starter overoad relay in the power line. Recognizing that this is theory only, and with our own experience to disprove the "infallibility" of motor starter overload relays, the Hampton Roads Sanitation District Commission has been employing a new relay testing technique to assure that motors at sewage pumping stations are fully protected against destructive electrical fluctuations.

The Commission operates 38 automatic sewage pumping stations, as well as three fully attended sewage treatment plants. Since the greater number of the sewage pumping stations are each equipped with two electrically driven pumps operating on 220-volt, 60-cycle, 3-phase power, and total dependence for proper operation of the entire facility rests squarely on these units, it has been standard procedure to inspect this equipment daily. But despite these precautions, motors continued to fail.

So-called "expected outages," however, were not accepted as inevitable. By isolating and dismissing other possible causes of motor burnout, it seemed probably that overload protective equipment might not have been giving the degree of protection for which it was designed and installed.

As is customary, the Commissions' overload relay heaters were selected from tables of averages supplied by motor manufacturers. Predicated as these tables are on normal loads and average ambient conditions, a doubt existed as to their performance in locations where there are sharp deviations from the calculated ideal "norms." It was not unreasonable to speculate that this was the case here, and that motor losses were caused by improperly calibrated protective devices or those which were subjected to internal and external stresses that drastically changed their operating characteristics.

A new testing technique based on the Multi-Amp* Model 1010 portable high-current testing instrument was put into motion to fill this gap in the Commission's important preventive maintenance picture. The Multi-Amp Model 1010 is, fundamentally, a variable high-current power source which produces a primary current adjustable in stepless increments in a number of useful ranges from 0 to 500 amperes. Amperages are recorded on an ammeter while trip-times are registered on a timing device used in conjunction with the tester. The Multi-Amp connects to any standard 110-volt outlet and long flexible leads from its

* Manufactured by Multi-Amp Corporation, Newark, N. J.

PUMP ROOM of Lamberts Point sewage treatment plant contains main control center and three of four installed sewage pumps, ranging from 30 to 75 hp. A Multi-Amp test is being performed on mezzanine landing.

MULTI AMP being used for timing test on overload relay of a 75-hp magnetic motor starter. This is a critical test, as the relay is sensing reduced amperage through 60-to-1 transformers; that is, with 220-amp motor current the overload relay sensed only 3.7 amps. The relay must trip on slight current increase, because such small increases actually reflect 60 times those values for motor protection. In noisy locations it is nearly impossible to hear the relay trip. An ohmmeter (atop Multi-Amp) connected across the closed contacts of the overload relay detects tripping action.

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outlet terminals can be placed across the relay element without disturbing either the relay itself or adjacent equipment. Trip-time determination with any desired current is rapid, safe and convenient.

The Commission's preventive maintenance program is conducted as follows: In all two-pump installations, one pump is normally operated in lead position to handle the total load, while the second unit is on standby duty. A switch-over is made once weekly.

Since control equipment on the active unit is at operating warmth and overload relay on the standby motor is cold, proper compensation for testing purposes is made by applying a load equal to 100 per cent of the normal motor load on the operating (hot) relay for a 3-minute pre-heat period. This is followed by a 200 per cent load test to determine trip time. The result is recorded. After cooling for one hour, the relay is subjected to a 3-minute pre-heat at 100 per cent of the normal load, and a second trip-time test is performed at 200 per cent of the normal motor load. Again, the results are noted.

The inactive (cold) starter is immediately given a trip-time test at 200 per cent of rated capacity, allowed to cool for one hour, and then given a 3-minute pre-heat at 100 per cent of the normal motor load. final trip-time test is made at 200 per cent of the normal motor load. A and results are recorded. When the series of test runs is completed, the inspector can not only determine and recalibrate those overload relays which are inoperative or faulty, but his findings also are the basis for a choice between various types and different brands. The importance of

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TIMING TEST of one phase of the 100-amp circuit breaker of a 25-hp combination magnetic motor starter. Proper calibration of electrical protective devices is critical because of the great possibility of pump impellers becoming jammed, or their rotation otherwise becoming impeded, thus throwing dangerously heavy loads on the motors—loads which must be prevented from damaging the motors.

maintaining a system of electrically-actuated protective devices which steadfastly remain in proper calibration cannot be overestimated, and the Multi-Amp method of detecting deficient relays has to date removed a number of suspected or potential troublespots.

We have already discovered that, for their purposes, certain types of overload relays stay in sufficiently good calibration for holding consistent trip-times under 1½ minutes. Other types which were formerly in use at the pumping stations showed serious misalignment, some failing to trip at 200 per cent normal loading after a 15- to 20-minute heat run. Although heaters for these unresponsive relays were selected from the usual normal tables, the actual protection which was afforded for vital motors was nil.

The Commission has already used the results of its own testing in writing specifications for new equipment. It now specifies overload relays of one make (found to remain consistently in proper calibration), regardless of the manufacturer.

An interesting by-product of the testing program developed when a prominent electrical manufacturer was informed that its larger relays were consistently out of calibration as evidenced by extensive Multi-Amp test results. The manufacturer, grateful for receiving accurate field data from a user, indicated that this information would be intimately applied to a program of redesign and improvement which was contemplated for its new overload relay line.

At present, the Multi-Amp technique has clearly defined the difficulties; the suspected problems have been successfully resolved by either calibrating or replacing improperly adjusted relays. Corrective action has meant renewed security in operating continuity and a significantly reduced motor maintenance and replacement bill.

TIME TEST on overload relay at electrical shop test bench prior to installation with a new 50-hp magnetic motor starter in an unattended sewage pumping station.

Chicago Fluoridates

May Day in Chicago was marked by an unusual and meaningful type of political demonstration. Mayor Daley led his official family and leading representatives of the medical, dental and public health professions in an appropriate ceremony at the South District Filtration Plant. This ceremony spot-lighted the inauguration of Chicago's water fluoridation program. The occasion represented the culmination of a five year effort to obtain city-wide fluoridation which was spear-headed by Alderman Alfred J. Cilella. Active support for this progressive public health measure also came from other members of the City Council, as well as Mayor Daley and leading medical, dental and public health authorities.

Opponents of the fluoridation program picketed City Hall on April 30 and the South District Filtration Plant on May 1. Picket signs and posters gave clear indication of the ignorance and superstition of many of those who still oppose the fluoridation of water. Typical slogans were "Fluorides Harden Children's Teeth; Why Not Your Bones", "Fluoridation Consumes Calcium and Your Bones Become Brittle", and "God Gives Pure Water—Should Man Poison It?"

Mayor Daley termed the occasion "another step in striving to make Chicago one of the most progressive and modern of U. S. Cities." Dr. Maurice Hoeltgen, president of the Chicago Medical Society, congratulated the city authorities on "an excellent piece of preventive medicine." Dr. G. W. Solfrank, president of the Chicago Dental Society, offered his commendation, with the statement that the measure would provide an effective reduction in tooth decay without physical harm.

BILL SAYS: that "Ole Liz" had pups last night and that you are selling 'em. How much?

The fluoridation installation at the South District Filtration Plant will serve about 1,350,000 of the 4,358,000 population served by the Chicago water system. Additional fluoridation installations are under construction at the Lakeview and Chicago Avenue Pumping Stations. These will fluoridate the remainder of Chicago's water supply and will be placed in operation on July 1, 1956. All installations will feed hydrofluosilicic acid purchased in the economical tank car lots—*Dave Howells.*

[Ed Note: In this same issue is an article dealing with Hydrofluosidic Acid for Water Fluoridation". Therein, pictures of tank-car delivery, handling, storage and feeding of fluosilic acid at Chicago are featured.]

PACKAGE-TYPE sewage treatment plant for 2,500 persons in Haifa includes aerator-clarifier (left), digester and sludge beds.

Haifa's Modern Sewage Treatment Plants

Made possible through American cooperation and aid

by S. GOLDSTEIN
Technical Writer,
Haifa, Israel

AN AMERICAN-DESIGNED $3,500,000 scheme involving construction of new public sewers and a modern treatment plant is being launched by the Municipality of Haifa (population about 180,000) and may herald the beginning of other similar schemes in a country where expanding towns and water scarcity present similar problems.

The Haifa project was brought about by (a) rapid growth of population due to non-stop immigration; (b) the resulting extensive housing and industrial development; (c) the importance of agriculture and industry, which are dependent on the availability of water; and (d) the importance of the beach and port area, which demands abatement of pollution.

Inasmuch as the first two points apply to many other Israeli communities, while the third one is, in fact, the primary problem of Israel as a whole, the Haifa scheme may set an example for what many other municipalities may be led to undertake in the foreseeable future.

Sewer System

The Haifa sewerage net is extensively built. Almost 250 kilometers of public sewers cover (a) the entirety of the Lower Town (port area); (b) plus 60 per cent of the slopes and Carmel hills, where residential quarters are mushrooming; (c) plus about 30 per cent of Haifa Bay, largest industrial area in the country.

The present system is based on several sea outfalls which pollute the city's extensive waterfront, including the beach and the port vicinity. About two years ago, large-scale improvements of the port involved the extension of an outfall beyond the port area, this being apparently a temporary solution.

A lengthy on-the-spot study by M. H. Klegerman of Alexander Potter Associates, New York, resulted in a master plan entailing the discharge of the sewage and its utilization for irrigation and industrial purposes, thus helping to alleviate the country's water shortages. The plan provides for the construction of a 9-kilometer main intercepting sewer along the sea front, across the Lower Town, which will receive the sewage from various outlets now discharging to the sea, and also from future sub-trunk

sewers as might be projected for newly-developed parts of the city.

Working under Sanitary Engineer Abraham Erlich, the Municipality's technical services are starting the implementation of the first part of the scheme, a 1.5-kilometer long section of the main intercepting sewer which will be of 32-inch spun concrete pipes, 4 inches thick, in sections of about 8 feet, locally-made, non-reinforced, to avoid any possibility of danger from rusting. Excavations for the main interceptor will aggregate about 85,000 cubic meters, mostly in rocky soil and, for about two kilometers in the vicinity of the treatment plant, in heavy clay. In this section, the interceptor will lie below the ground water level and the trench will have to be pumped during the laying of the pipes.

The main interceptor will convey the sewage by gravity to the treatment plant, which will be erected near the oil refineries on the left bank of the Kishon River. The plant effluent will be reclaimed for irrigation and industrial purposes.

The industrial area stretching to the east and north of the Lower Town will be provided with a net of pumping stations and force mains to convey the sewage to the plant. The force main consists of about 12 kilometers of 12-inch diameter cast-iron pipe, purchased in the United States.

The Treatment Plant

The plant's capacity will be 4 mgd in the first stage, 8 mgd for the current needs, with possibilities of enlargement up to 16 mgd, which corresponds to the estimated development of Haifa by 1990.

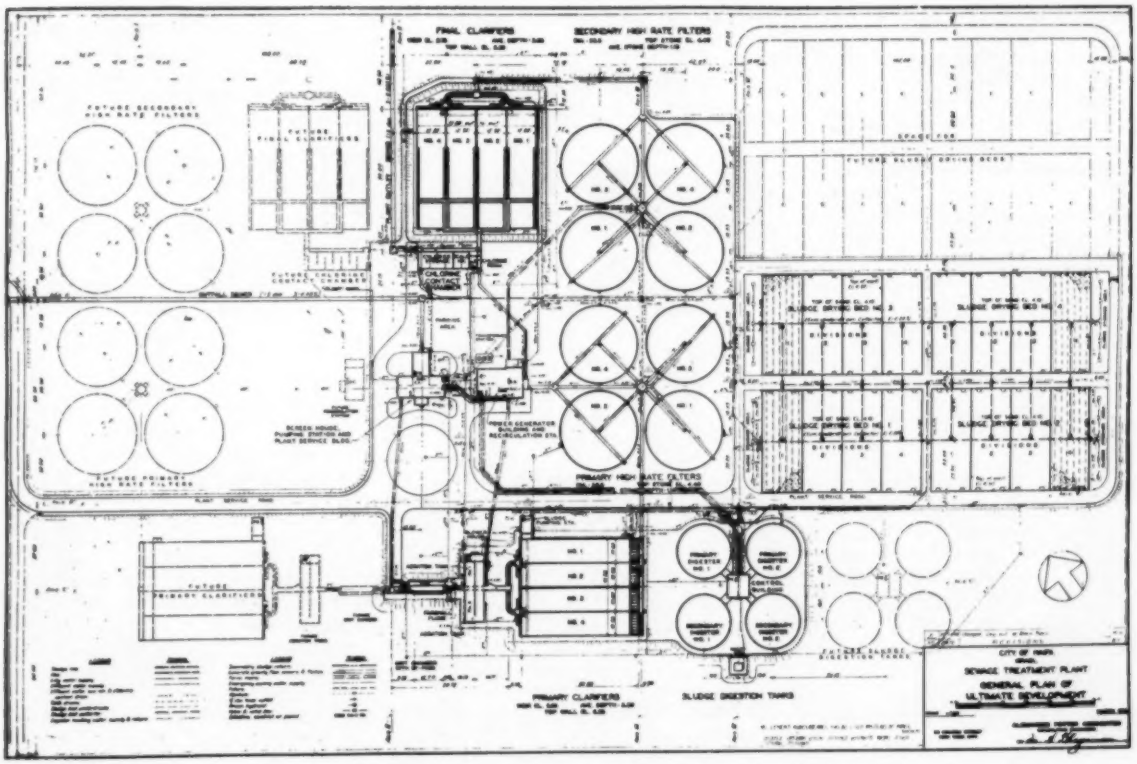
Here, too, American "know-how" was made available to young Israel in the form of machinery suppiled by Link-Belt, Dorr Co., Chicago Pump Co., Westinghouse, and Fairbanks-Morse. The foreign equipment (75 per cent of which is already in Israel) cost a total of $360,000, paid out of a United States loan.

Sewage will be treated by sedimentation and high-rate biofiltration, in two stages, with recirculation. This is expected to give 90 per cent efficiency of treatment and make the effluent suitable for discharge to the Kishon River without health menace, for agricultural use without limitation as to crop, and for industrial purposes.

The sludge will be digested in heated Dorr digesters and dried on open beds.

A feature of local sewage is the concentration of solids and organic matter, which is three to four times higher than the average in the United States. This fact was taken into account by the designer of the plant, but did not necessitate any departure from the standard equipment used in the States.

A specific point in the vast problem was the servicing of the distant area on the western slopes of the Carmel hills. Its linking with the city's general sewage system being rather costly, the Municipality envisages the erection of several small package plants for the treatment of sewage by the activated sludge process. Each such package plant would service a population of 2,500 and provide water for artificial irrigation in this part of the area. Construction of the first one, supplied on a gift basis by the Chicago Pump Company, has been completed and will service experimental farms in the neighborhood. This formula, too, may provide a solution to similar problems in other Israeli localities.



GENERAL PLAN of present 8-mgd and ultimate 16-mgd sewage treatment plant for Haifa, Israel

SOME OF THE 215 members and guests attending the Silver Anniversary Meeting.

Arkansas W. & S. Conference Celebrates Silver Anniversary

Now one quarter of a century old, the Arkansas Water and Sewage Conference held its silver anniversary meeting and short school in Little Rock, Ark., March 19-20-21. The attendance was 215.

Perhaps the high spot in the 25th anniversary meeting of the Arkansas Conference was the recommendation of a Special Committee on Operator Licensing that Compulsory Operator Licensing now be substituted for the Voluntary Licensing which the Conference adopted some years ago as an early experiment in licensing. The committee recommendation (J. J. Highfill, Chairman) was approved by vote of the Conference and Steering Committees which will participate in the drafting of the required legislation and licensing requirements.

Dr. Harrison Hale, Professor of Chemistry at Southern State College, Magnolia, Ark., who has served as Secretary-Treasurer of the Arkansas Conference since its organization twenty-five years ago, retired from office and was named Honorary Secretary. In appreciation of long service he was presented with a handsome TV set.

Officers for 1956-57

The following were elected officers for the 1956-1957 Conference year.

John Luce, Chairman
Foster Burba, Vice-Chairman
Chas. W. Oxford, Secy.-Treas.
Harrison Hale, Honorary Secy.
Gaston Bell, Program Chairman

Executive Committee
John Luce (Ft. Smith); Luther Owens Berryville); E. L. Lunsford (Mena); Byron Burke (Fordyce); Wyatt Crawford (Benton); Gaylord Strong (Clarksville); John Welch (Brinkby); B. B. Dallas (Caraway).

The Technical Program

First Day

Progress Made in Complying with Requirements for Drinking Water Standards .....*Glen T. Kellogg*
Quarter Century of Progress in Water and Sewage Works .....*F. L. McDonald*
Sewage Section Luncheon Speaker .....*Ralph E. Fuhrman*
Selling Your Sewage Works to the Customer .....*Neal B. Thayer*
Use of Coil Filters in Sewage Treatment .....*Max A. Mehlburger*
Use of Oxidation Ponds in Sewage Treatment .....*Marvin Wood*
Sewage Problems in Fringe Area Development .....*Hollis R. Conway*

Second Day

PANEL DISCUSSION: Water Main Extension Policies .....*Bob Rimmer*
Jack Wilson .....*W. C. Smith*
W. J. Weems .....*Al Kapp*
Iron Removal .....*W. A. Mayhan*
Corrosion Control in Distribution System .....*W. E. Pfeiffer*
Industrial Demands on Waterworks Systems .....*William P. Rock*
Water Section Luncheon Speaker .....*J. Richard Pierce*
Maps and Records for Waterworks Systems .....*Ray C. Haws*
Need in Arkansas for Water Rights Legislation .....*Hon. Marvin M. Melton*
Little Rock's Plans for the Future .....*Beverly E. Ryan*
Liability in Water and Sewage Works Systems .....*Glenn G. Zimmerman*

Annual Dinner

Address by .....*Dr. Harrison Hale*
"Twenty-five Years of the Conference"

Third Day

PANEL DISCUSSION: Service Line and Meter Sizing and Installation .....*Marion Ulmer*
Ted Gentry .....*Louie M. Preedom*
Vell Hall .....*Solon Sanderson*
Ground Water Recharge in Arkansas .....*R. T. Sniegcocki*
Upflow Clarification in Water Treatment .....*V. M. Roach*
Construction Practices in Water and Sewage Works .....*E. F. Bespalow*
Useful Records to Keep for a Well System .....*Bob Rimmer*
Theory and Use of Automatic Controls in Operation of Water and Sewage Works Systems ....*Neal Thayer, Marion Ulmer*

SEWAGE WORKS PRACTICES

Sewage Lagoons

The Fourth Article of a Series

IN RECENT YEARS many articles have appeared in various journals reporting the use of lagoons, or oxidation ponds, for sewage and industrial waste treatment. The manner in which these lagoons are used varies; sometimes it is the sole method of treatment, at other times it is an auxiliary method. What then is a lagoon, how does it work, and where can it be used?

by THEODORE JAFFE

Mr. Jaffe is Professor of Civil Engineering, Alabama Polytechnic Institute, Auburn, Ala. In this series of articles for the practical sewage treatment plant operator, he discusses matters of interest generally overlooked in the press of routine duties.

What a Lagoon Is

A lagoon is a shallow basin in which the sewage or industrial waste is held for a period of time such that some desired degree of stabilization occurs. There may or may not be an effluent from a lagoon. Some are so designed that evaporation and percolation proceed at a rate sufficient to

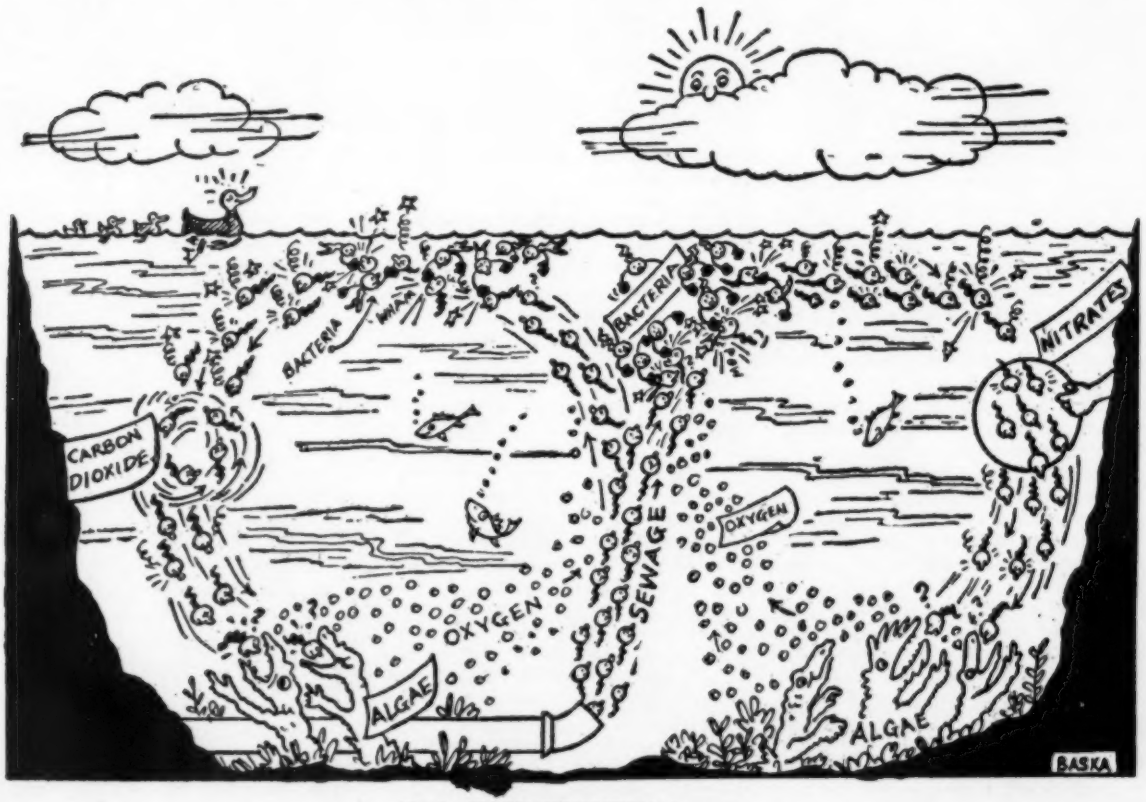


Fig. 1—WASTE TREATMENT in lagoons

(As depicted by artist Wilfred Baska. Originally published in **Official Bulletin**, N. Dak. Water and Sewage Works Conf., and **Sewage and Industrial Wastes**, Vol. 26, p. 239; 1954. Reprinted by permission)

keep all the waste within the lagoon; others are designed for continuous effluent flow. Lagoons have banked edges of sufficient thickness to contain the waste waters. These banks have an inside slope of about 4 to 1, to reduce the erosion effects of any wave action due to winds. The entire area within the lagoon is usually stripped of vegetation, and the top and outer sides of the retaining banks are grassed.

Lagoons may be constructed so that the waste waters are from 3 to 5 feet deep, with an additional 3 feet of freeboard provided. The detention time in the lagoon varies according to the waste, the amount of pretreatment, and the removals desired. It may range from less than 1 day to 120 days. It is recommended[13] "that the sewage should be discharged into the center of the lagoon slightly above bottom elevation." B.O.D. loadings will be discussed after a brief description of how these lagoons achieve waste water stabilization.

How Lagoons Work

In oxidation ponds, treatment is accomplished by nature with very little assistance from man. If sufficient time and sunshine are provided bacteria and algae, with the help of occasional wind action, stabilize the organic matter in the waste water. (Fig. 1). Where the velocity of flow is reduced on entering the lagoon, suspended and settleable solids will be deposited. These plus the dissolved organic matter are the foodstuffs for the forces of nature.

Oxygen is supplied on the surface and stirred in by wind action. Additional oxygen is made available by green plants; hence, the need for shallow lagoons so that these plants may receive the sunlight they require. Bacterial decomposition of the deposited or dissolved solids furnishes carbon dioxide.

Other nutrients, such as nitrogen and phosphorus, are also available from the sewage.

If any of these foodstuffs is not present (as may be the case with industrial wastes) it must be supplied by man; if toxic materials are present they must be removed before entering the lagoon.

Several other factors should be considered in the lagooning of liquid wastes. Due to the wide shallow area exposed to the atmosphere, evaporation of water will take place. Further, some percolation of water into the ground will also occur. Both of these tend to reduce the volume of waste to be disposed. Consequently, the use of lagoons is most efficient where these two factors are high. In North Dakota average evaporation rates amount to 1,340 gpad (18 inches per year). With percolation rates of ¼ to ⅛ inches per day, the total water loss from the lagoon will vary from 4,773 to 408,206 gpad[14]. At Victoria, Texas, it is estimated[4] that an average evaporation rate of 16 inches per year is obtained.

Some readers may wonder about the possibility of ground water contamination by percolation of the lagoon waters. This is always possible and should be investigated before lagooning is adopted for waste treatment. However, in passing through a lagoon a certain amount of bacterial reduction occurs. In a study of sewage lagoons in Australia it was reported[8] that a reduction of coliform organisms from 800,000 per ml in the raw sewage to 350 per ml in the effluent was obtained. Warrington[17] reported that a reduction of coliform bacteria from an M.P.N. of 1,100,000 to 450 per ml was obtained with a detention period of better than 30 days. These reductions in coliform organisms are primarily due to the action of natural enemies on these bacteria.

Lagoons may be designed to discharge a continuous effluent just as a sewage plant does, or if sufficient area is available, to rely upon evaporation and percolation to the extent that no effluent or discharge occurs. When an effluent is discharged it will usually be lower in B.O.D. and sewage solids; high in organic nitrogen; have considerable phosphorus, potassium, sodium; and have a lower coliform count. In addition it will probably be supersaturated with dissolved oxygen.

This state of supersaturation is due to the action of algae in the oxidation ponds. Algae are simple, one-celled green (or blue-green) plants that live in streams. They and the bacteria do the major part of the work in lagoons. This working as a team and living together is called symbiosis. The bacteria in the lagoons break down the organic carbon materials in the sewage to carbon dioxide. The algae take this carbon dioxide, and other nutrients, into their systems and give off oxygen. To perform their jobs, the algae need sunshine. In the presence of sunlight more oxygen can be produced by the algae than can normally be held in the water. As a result of this extra "oxygen pressure" the water becomes supersaturated with oxygen. Because it is always desirable to produce a plant effluent containing as much dissolved oxygen as possible, lagoon effluents are highly desirable on this score.

It should be noted that the effluent from an oxidation pond may actually contain more organic matter than the sewage entering. This increase will be due to the algae cells previously discussed and will be an asset to a stream rather than a liability, as would the sewage. The sewage organic material is highly putrescible and contains harmful microorganisms. The algae cells are neither putrescible nor harmful. Actually, they may be a source of food for fish and other aquatic life.

One further remark should be made on the reactions occurring within the lagoon. Because the stabilization of the sewage is a biochemical phenomenon, its rate of reaction is dependent upon the temperature. In winter, the efficiency (and the removal) decreases; in summer the efficiency increases. Tests run in North Dakota showed 65 per cent B.O.D. removals in winter and 95 per cent in summer on raw sewage[1]. This, however, is not a defect of the process, for during the winter most streams run full and can handle more of a load than in summer when they are low or even dry. Lagoon effluents fit in well with nature's scheme of things.

Uses of Lagoons

The lagooning of sewage is conducted in many ways for various purposes. It has been used on industrial wastes and on domestic sewage. It has been used for partial treatment (either pre- or post-treatment) and for complete treatment with or without an effluent discharge. Apparently it is an adaptable method of waste water treatment. Depending upon its use, the design bases will vary.

For normal domestic sewages without industrial wastes, a liquid depth of 3 to 5 feet with about 3 feet of additional freeboard seems to be standard. Detention times in the lagoon vary from a low of 15 days up to 120 days. Loading parameters found in the literature are of four types:

1. B.O.D. applied; for example 45 lb of 5-day 20°C. B.O.D. per acre per day[3].
2. Area-population; for example, 10 acres of lagoon per 1,000 population[15].
3. Capacity-population; for example, 200 times the daily sewage flow[15].
4. B.O.D. removed; for example 65 lb of B.O.D. removed per acre per day[9].

The parameters dealing with B.O.D. (items 1 and 4) are used where an effluent of a desired quality

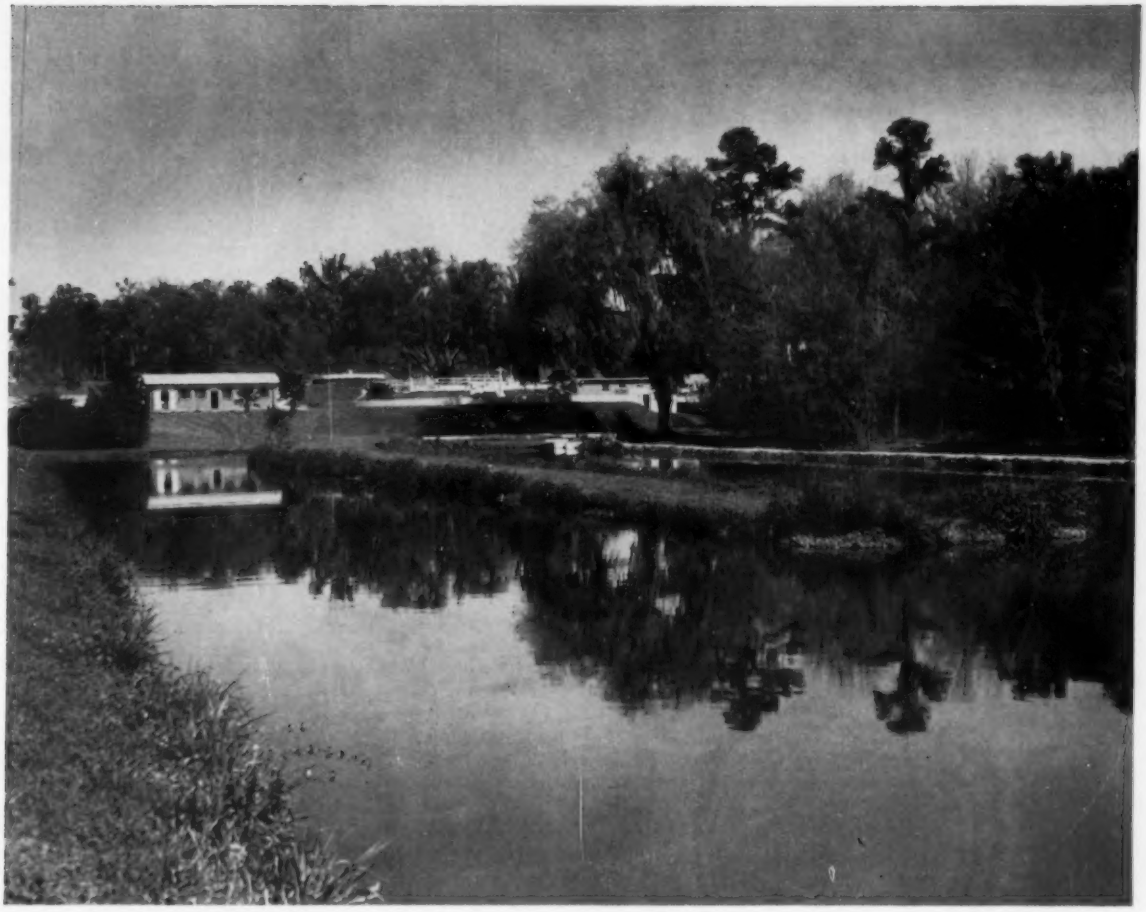


Fig. 2—OXIDATION POND at University of Florida sewage treatment plant. Influent is at upper left, effluent at upper right. Note luxuriant growth on banks, although photo was taken in February

is to be produced. Where no effluent is to be produced, parameters 2 or 3 have been used. These four bases are for lagoons designed to furnish complete treatment for a sewage. Where the objective of the oxidation pond is not complete treatment, other criteria are used.

One use to which lagoons may be put is that of a finishing unit for plants that are overloaded or where a high quality effluent is desired. The University of Florida's sewage treatment plant utilizes a lagoon as a finishing or polishing unit for its filters (Fig. 2). This lagoon is about 500 feet in length, 28 feet wide, and has an average depth of 4 feet. The average detention time is about 17 hours in winter and 20 hours in summer. Although the plant effluent entering the lagoon is very satisfactory, the lagoon improves it still further. Table 1 shows the work done.

The B.O.D. removal was 32 per cent in winter and 45 per cent in summer; the suspended solids removed was 73 per cent and 51 per cent for the corresponding seasons. It is interesting to note that the D.O. dropped 18 per cent in winter, but increased 28 per cent in summer. In fact, during summer midafternoons the lagoon effluent would contain as much as 21 ppm of D.O., due to the abundant algae growths.

The numerical data do not tell the full story. A lagoon of this type has a tremendous public relations value. This lagoon is actually a beauty spot on the campus. Due to the warm temperature, even during the winter, and the nitrogen value of the effluent, which is used for lawn watering, the vegetation around the plant remains green all year long. The lagoon itself is a small-scale zoo. At the lagoon minnows, turtles, catfish, alligators, bass, ducks, herons, egrets, and other forms of life have been seen or caught. Naturally, with the high D.O. in the lagoon, no odors have been noticed. It is not at all unusual

TABLE 1
Data on Performance of University of Florida Sewage Plant Polishing Lagoon[5]

Months	Temp., °F	B.O.D., ppm		Susp. Solids, ppm		D.O., ppm	
		Infl.	Effl.	Infl.	Effl.	Infl.	Effl.
Jan.-May	73	10.7	7.3	11.	3.	5.6	4.6
June-Aug.	84	5.6	3.0	7.	3.	4.6	5.9

to see parents bring their children to this spot to show them the "wild life". How many other sewage plants can make this statement?

Lagoons for treating domestic sewage are feasible where land is cheap and available. It is usually good practice to buy more land than immediately required so that as the community grows, adequate treatment may be provided. Lagoons work best where the climate is warm, dry and sunny.

The maintenance of lagoons is simple and inexpensive. The area around the lagoon should be fenced to keep out animals and children. Grass and weed cutting must be carried on so as not to cut down wind action. The dikes must be inspected to prevent failures, break-throughs, or undermining.

One of the questions frequently asked is whether the sludge need be removed from the lagoon and how frequently? In Fessenden, North Dakota, a sewage lagoon has been successfully operated without removing any sludge for 24 years with no appreciable decrease in capacity or efficiency of seepage rates."[16]

Industrial Waste Lagoons

The use of lagoons for the treatment of industrial wastes has been successfully practiced in many locations. A partial list of the various industries that have reported on waste treatment lagoons is given in Table 2.

TABLE 2
Some Industries Reporting Use of Industrial Waste Lagoons

Frozen food processing
Poultry dressing
Cheese
Synthetic rubber
Beet sugar
Vegetable canning
Paper and pulp
Citrus concentrating
Milk and dairy products
Radioactive wastes

Industrial waste lagoons operate in the same manner as those treating domestic sewage. One of the most important factors to be kept in mind is that the lagoon will operate satisfactorily only if a balanced diet is available for the microorganisms. This may be difficult to achieve in some industrial waste situations, and some wastes may require the addition of chemicals; for example, some form of nitrogen for wastes predominately carbohydrate. If the diet of the microorganisms in the lagoon is too one-sided, the anaerobes may take over and unpleasant odors may result.

Another factor to be kept in mind, especially when starting a lagoon in operation, is that of letting the microorganisms become accustomed to the waste. This idea is similar to that used in starting an activated sludge plant or a sludge digester. Small amounts of the waste are fed into the lagoon at first, this being increased as the microbial life in the lagoon begins to work and multiply.

One of the determining factors as to whether lagoons or some other form of treatment is adopted is the availability, the cost, and the type of land. Some seasonal industries, such as vegetable canneries, build lagoons to hold an entire season's waste. They rely on some percolation into the ground and some evaporation into the atmosphere during the season. The major portion of waste stabilization occurs in the lagoon after, or during the later months of the season.

One of the reasons for this is that a lagoon, just as any other type of secondary treatment unit, requires a maturing period before it can effectively reduce the B.O.D. During the maturing, with constant flow into it, the lagoon may become devoid of oxygen and require attention. Industries have found that the addition of sodium nitrate is effective in this situation[2, 6, 7]. After this stage however, the lagoon will begin to stabilize the waste and a satisfactory effluent is produced.

Other industries have found that lagoons with an outlet are satisfactory for reducing the pollutional nature of their wastes. One of the citrus concentrate plants in Florida uses continuous-flow lagoons after chemical treatment (Fig. 3). The lagoon is 375 feet wide and 2,000 feet long, with an average depth of 1.5 feet. The flow varies between 275 and 400 gpm. The lagoon influent has an average B.O.D. of 4,550 ppm and the effluent averages 1,800 ppm[10]. In view of the large peel oil content of the influent (which has a somewhat toxic effect on the microbial life) this is a reasonable reduction in B.O.D. In this particular situation the addition of phosphate and nitrate has been found beneficial.

For some types of industrial wastes it has been found effective to operate lagoons in series. Two or more ponds are so arranged that the flow from the first enters the second, that from the second enters the third, and so on until the desired degree of removal is accomplished. The basic idea in this type of operation is similar to that of recirculation through a trickling filter. The first lagoon removes part of the B.O.D. load, the second removes another portion of that left by the first, and so forth. This type of operation has been used in the treatment of paper mill wastes[11], vegetable cannery wastes[12], and others.

It should be pointed out that many types of industrial wastes contain inorganic settleable solids in addition to dissolved or colloidal organic matter. Where lagooning is being considered as a means of treating this kind of waste, it would be advisable to investigate the effectiveness of presettling ahead of the oxidation pond. It has been found that where this was not done the detention time in the lagoon soon decreased due to the volume occupied by the settled solids. This not only causes a reduction in B.O.D. removal, but may mean anaerobic conditions (and odors) in the first part of the lagoon, and further, will lead to more difficult sludge removal and disposal problems.

Summary and Conclusions

To summarize, lagoons or oxidation ponds have been proven successful as a means of sewage and industrial waste treatment. The basic criterion as to whether lagoons or some other method of treatment shall be chosen is an economic one. Where land is cheap, available, and plentiful; where low operation and maintenance is desired; where very little operation is a governing factor, the choice might very likely be in favor of lagoons.

Oxidation ponds, as discussed here, are secondary treatment units, biological in action. Other types of lagoons are in use also; for example, sedimentation lagoons. The oxidation ponds may be so designed as to require no further disposal or they may be designed with an outlet. Rates of evaporation and percolation, winds, rainfall, sunshine, are some of the relevant factors here. Details on loadings, construction, operation, etc., are best determined in each situation. Much detailed information exists in the literature, only a small portion being listed in this article.

Before concluding, mention should be made of the work previously referred to by Parker et al.[8]. During the course of these investigations on domestic sewage, an anaerobic lagoon was set up followed by an aerobic one. They found that the anaerobic lagoon could remove 600 lb of B.O.D. per acre per day in 5 days during the summer (64°F) and 450 lb of B.O.D. per acre per day in the winter (52°F). The aerobic lagoon

Fig. 3—AN INDUSTRIAL WASTE oxidation pond at Winter Haven, Fla.

had a maximum removal at 82 lb of B.O.D. per acre per day, but a loading of only 65 lb per acre per day was recommended for the best quality effluent.

They further decided that for anaerobic lagoons the capacity or detention time was the most important factor, whereas for aerobic lagoons surface area was more important. It would be most interesting to see further work along these lines. This author is currently investigating the disposal of starch desizing wastes from a textile finishing plant along these lines of thought.

The next article in this series will be concerned with some of the newer developments and modifications in the activated sludge process of sewage treatment.

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Lt. Col. Berry Appointed Chief, Sanitary Section, MSC

Lt. Col. Floyd L. Berry, MSC, was appointed Chief, Sanitary Engineering Section, Medical Service Corps, effective March 25, 1956.

Colonel Berry has served as Chief, Sanitary Engineering Section, Environmental Hygiene Branch, in the Preventive Medicine Division of the Office of the Army Surgeon General, since August 10, 1955.

A native of Dalton, Ga., Colonel Berry received his undergraduate training at Georgia Institute of Technology and at the University of North Carolina. He was appointed to the Sanitary Corps reserve in 1940 and served in Europe, the Pacific, and the Far East, in World War II, and later in Japan and Korea. He received his Master of Science degree in sanitary engineering at Johns Hopkins University in 1947.

Arthur W. Consoer Cited by Univ. of Wisconsin

Arthur W. Consoer, Chief Partner of the well know firm Consoer, Townsend & Associates, consulting engineers of Chicago has been cited by his alma mater, The University of Wisconsin, from which he was graduated in 1914.

The University Board of Regents chose Mr. Consoer to receive the citation "for outstanding accomplishments" in the field of sanitary engineering. The distinguished service citation was presented at the 8th Annual Engineering Day Dinner at the University on May 4th attended by about 400 engineering graduates of the University.

In addition to his engineering acumen Mr. Consoer is well known for his activity in civic and social welfare work in his native city, Chicago.

E. R. Bowen Dies

Edward R. Bowen of Pasadena, Calif., one of the consulting engineers who designed many of the principal structures of the Los Angeles Aqueduct, died in Los Angeles April 11, 1956. He was 71 years old.

Mr. Bowen was a former partner in the engineering offices of Lippincott & Bowen. He was known principally for his work on California water supply projects.

Mr. Bowen was a life member of the American Society of Civil Engineers and in 1941 served as president of the Los Angeles section. He also was a member of the American Water Works Association.

REPORT FROM ABROAD

Experiments with Gas Recirculation In Sludge Digestion Tanks

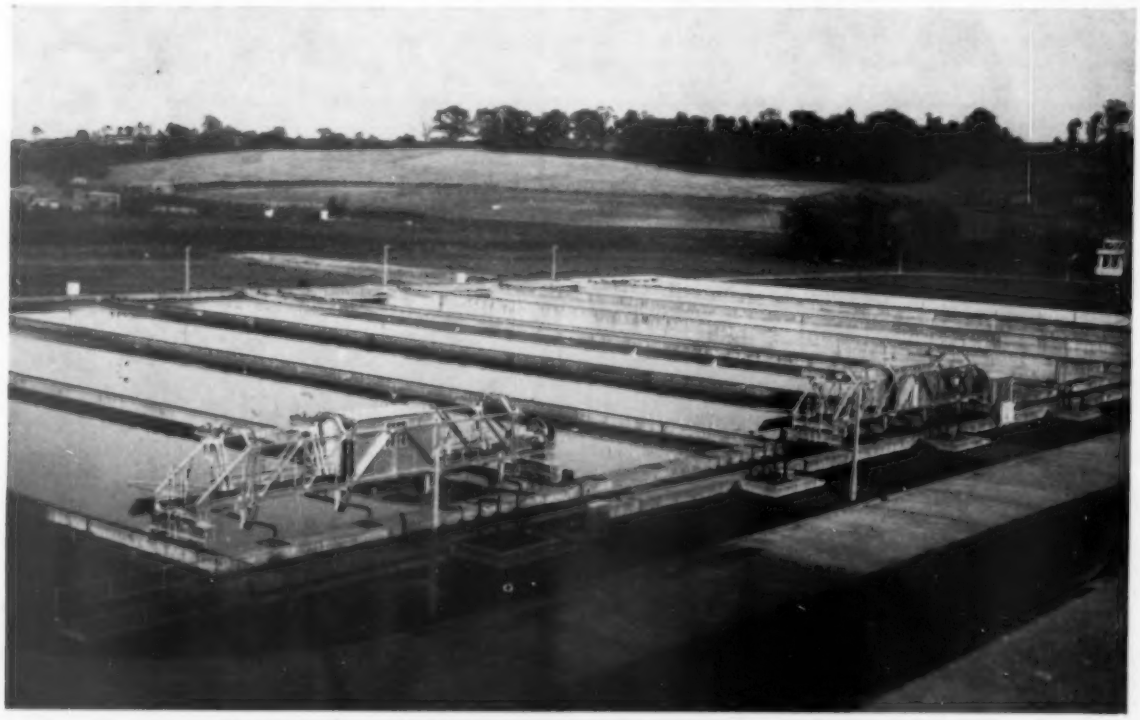
by JOHN FINCH

Mr. Finch is Manager of the Sewage Disposal Department, Slough, England. In his reports from abroad he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers desiring additional information regarding subjects covered in his series.

A PAPER which has been well received in England, having been presented to two Branches of the Institute of Sewage Purification, is the one originating at the Maple Cross works of the Colne Valley Sewerage Board entitled "Experiments with Gas Recirculation in Sludge Digestion Tanks", and authored by J. Griffiths and I. Withnell.

This is the first paper to be presented in England giving details of the operation of heated sludge digestion tanks equipped with this particular type of apparatus, and workers in the sewage treatment field have very naturally expressed great interest in an innovation of great simplicity which has obviated the difficuties encountered at Maple Cross in connection with the heavy scum deposits in the digesters.

The Colne Valley authorities had three digesters in which circulation and mixing of sludge was entirely unsatisfactory. Heavy scum deposits were formed, which, in one particular case prevented the floating steel dome from moving. Gas recirculation was put to work and scum deposits were kept under control in consequence.



PRIMARY settling tanks at Maple Cross works, showing travelling bridge sludge scrapers

AERATION PLANT, with power and blower building in background

In fact, their troubles were quite easily solved.

Despite the increase in effective capacity created by the disintegration of a 10-ft thick scum layer, it was found that the gas yield was not materially increased, which would appear to indicate that there was no shortage of digestion capacity in the first place. This being so, the Colne Valley authorities should now have spare digestion capacity for future commitments—a very nice state of affairs in England where instances of surplus capacity are few and far between!

Gas Recirculation

The sludge digestion plant at the Maple Lodge works of the Colne Valley Sewerage Board consists of four circular reinforced concrete tanks 75 feet in diameter and 30 feet deep, the bottom being slightly coned and falling 1 foot from the wall to the center. Mechanical equipment provided originally consisted of revolving scrapers at the bottom of each tank supported on the center columns and driven by geared motors at the head of the columns. The tanks are four in number and are grouped together in a square, the space between them being enclosed to form a control chamber. All the connecting pipework, valves and measuring equipment are housed in this chamber.

The tanks have floating steel gas domes, the three on those tanks used as primaries having 8-foot skirts and the fourth, on the secondary tank, a 12-foot skirt.

The three primary tanks are heated by internal 4-inch diameter galvanized steel coils on the walls through which is circulated hot water from the engine cooling system. The fourth tank is not heated. Apart from the sludge drawoff pipes, which are connected to the center of the tanks at the bottom, all of the connections are in the walls enclosing the operating chamber. These include the inlet at 8 feet below top sludge level, sampling or water removal valves at various depths, and the scum withdrawal trumpet. The latter consists of a rectangular box open at the top (3 ft 7 in by 1 ft 9 in) secured inside the tank under the dome and forming a weir at top water level.

The digestion tanks receive only primary sludge from the sedimentation tanks.

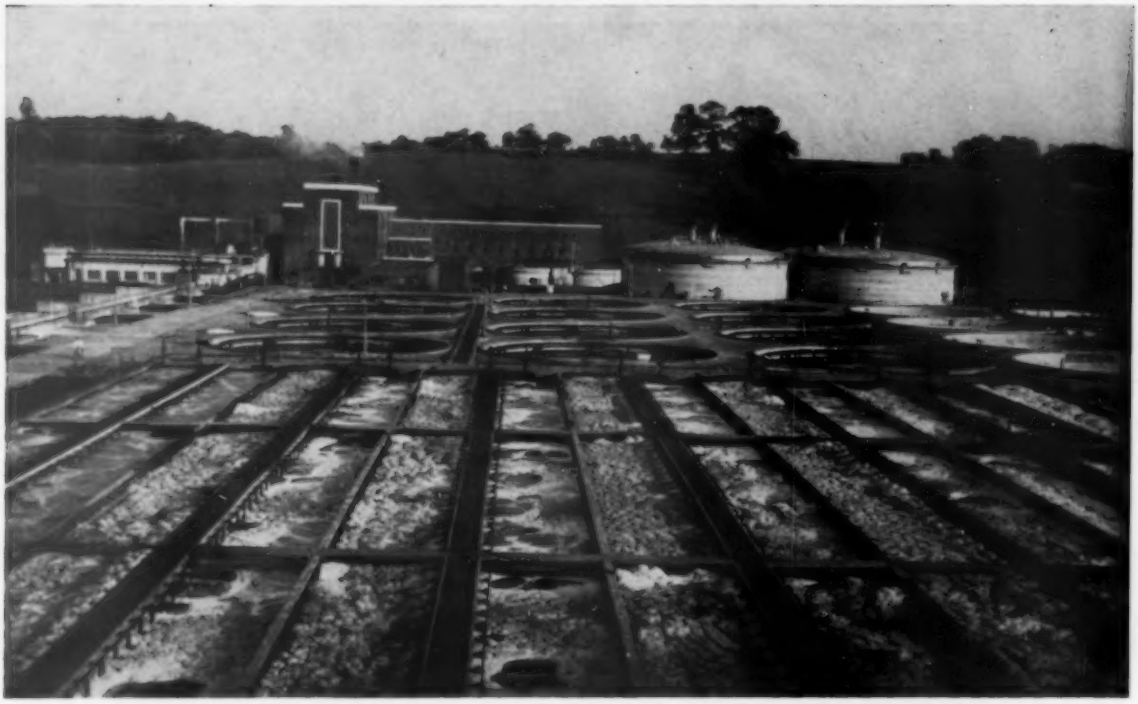
Sludge was first fed into the tanks in May 1951 and it soon became apparent that mixing in the tank was quite inadequate. It was impracticable to seed the incoming raw sewage without unduly prolonging the pumping time, as the maximum practicable rate of pumping sludge to the tanks was 200 gpm. The only means of mixing was by withdrawing sludge from the bottom of a tank and pumping in via the inlet through the same pumps and sludge line at the same rate.

In 1953 it became necessary to empty No. 1 digestion tank to carry out certain repairs to the floating dome. It had been known that scum was forming on the sludge surface in the primary tanks, but not until this particular tank was opened was it realized how serious the position was. The tank was covered with a thick scum, estimated at 7 to 8 feet thick, and a sample showed this scum to contain about 21 per cent of solid material having a volatile content of about 70 per cent. The solids contained much fibrous matter.

When the tank was returned to service an aatempt was made to prevent scum formation by means of a routine operation and twice each week the tank level was raised above the scum trumpet level in an endeavour to flush scum away as quickly as it formed. The routine, however, was not successful and use of the scum trumpet had to be discontinued.

Another difficulty encountered in the disposal of sludge at the Maple Lodge works involved operation of the vacuum filtration plant. It was found that the sludge from the digestion tanks was most difficult to filter and, contrary to expectation, activated sludge produced a very good filter cake.

Early in 1954 a more serious sit-



DIGESTION and sludge incinerator facilities (rear), with aeration plant in foreground

uation began to develop. The scum layer in two of the tanks had become so thick that it prevented free movement of the gas domes. It was estimated that the scum layer was in the region of at least 10 feet thick, or in other words, more than over 30 per cent of the tank capacity was ineffective. At this stage, Col. A. S. Lowe, a Partner of the Board's consulting engineers, returned from a tour of Canada and the United States with a suggestion that sludge gas blown into the upper layers of the tank might assist in the mixing of the tank contents and bring the scum into recirculation. Unfortunately, no details of this operation were available.

However, it was decided to proceed with a trial installation of this form of gas recirculation, the design of the installation being worked out jointly by the Sewerage Board's staff and the consulting engineers. The major problem was that of installing the necessary equipment without emptying the tanks of sludge. The following arrangement was eventually agreed upon and the layout was adopted for the three primary tanks.

The compressor unit is mounted on the dome near the crown, the 3-inch diameter suction pipe being taken from an adjacent hole drilled in the dome to gas delivery pipe feeds on a ring main, which in turn is connected to four 2-inch diameter pipes, separately valved, inserted through and extending 16 inches below the skin of the holder. These pipes are arranged at points 90° from each float and half-way along the radius.

The installation was carried out with the tank full. Therefore, it was impossible to give the pipe any support below the dome surface. To reduce the strain at the joint with the skin, the only point of support, the pipes were carried upwards 4 feet and brazed to a tripod which sits on and is not secured to the holder. The ends of the delivery pipe are made in the form of a "J", which directs the gas upwards. On fitting the pipes on tank No. 2 it was, in fact, found that the scum layer was 12 feet thick, containing 20.5 per cent total solids, of which 63.5 per cent was volatile matter.

The blower unit comprises a 65-cfm compressor driven by a 3-hp motor and the operating procedure is for the whole of the gas delivered to be fed to one downpipe for 24 hours, changing to the next 24 hours and so on on a four-day cycle. A similar installation was fitted on No. 1 digester and a 150cfm blower was fitted on the third digester. With the latter unit two downpipes are fed simultaneously, changing over each day to the other pair.

After the blowers were put into operation the effect at the surface appeared to be slow, but within a few days the mat of fibrous material began to form as a scum on the digested sludge in the elutriation tanks and caused occasional stoppage of pumps in the sludge disposal plant.

Within a few weeks the floating gas holder on No. 2 tank began to move freely and sampling outlets which had been completely blocked for months discharged freely.

Although analytical figures showed a reduction of volatile matter in the digested sludge after gas recirculation had commenced, there was no evidence of any increase in gas yield. A slight increase in gas yield did occur following the starting up of the first unit, but this was attributed to breakdown of the scum solids.

So far as the Maple Lodge works are concerned the application of this process of gas recirculation has been most successful and the immediate pressing problem of scum removal has been solved. Furthermore, an improvement in another direction has been achieved in the production of a digested sludge more easily dealt with on the vacuum filters. Finally, the authors suggest that a suitable rate for gas recirculation for digesters of the size in operation at the Maple

Lodge works is approximately 75 cfm of gas for a 75-foot digester and they also state that there are some indications that the rate of 150 cfm applied to the No. 3 digester is too high.

Discussion

In the discussion that followed the presentation of the paper, the trend of thought appeared to be that the paper was, in fact, a revelation of deficient design of the digester installation, this line of thought was variously expressed by the speakers, one delegate in particular putting the situation as he saw it in a very forthright manner.

Another delegate, C. B. Townend of the West Middlesex scheme, took the opportunity during the course of the discussion of the paper, of presenting to the meeting, perhaps the best discourse on the principles and practice of sludge digestion, starting with the early Birmingham work and researches, I have ever heard delivered in an extempore manner. At the same time, in the most honeyed and diplomatic phrases, it could have been argued that he delivered a most withering criticism of the design of any sludge digestion installation which produces scum of the order of 10 to 12 feet thick on the surface of the sludge.

Mr. Townend's contribution was, however, as almost always, of inestimable value to old and young alike in the art of sewage treatment, for he has the outstanding ability of being able to separate the wheat from the chaff to a greater extent than many others in the field.

One thing is very evident from an examination of the application of sludge digestion principles to any form of tank. That is that the intimate mixing of the raw sludge being introduced into the tank, with the digested sludge in the tank, is essential if digestion is to proceed satisfactorily.

At most sewage treatment plants it is usual to introduce the raw sludge into the digested sludge circulation circuit, for where circulation of the digesting sludge is carried out thoroughly, this point obviously offers the very best means of seeding and mixing the raw sludge with the digestion tank contents.

With the gas-circulation technique, there is presented an easy means of mixing and circulating sludge in the digestion tank.

Dr. Imhoff Honored by FSIWA on 80th Birthday

Dr. Karl Imhoff, Consulting Engineer of Essen, Germany, and Honorary Member of the Federation of Sewage and Industrial Wastes Associations, has been additionally honored by the Federation on his 80th birthday, April 7, 1956. At a gathering of German engineers in Bonn, Germany, on April 9, 1956, several new honors were bestowed on this world renowned sanitary engineer.

The Federation's recognition of this event took the form of an especially prepared plaque. The plaque has a facial likeness of Dr. Imhoff cast in bronze. Below it is a tablet with the following inscription:

Presented to
Dr. Ing. KARL IMHOFF

On his 80th Birthday, April 7, 1956, in grateful recognition of his invaluable contributions to world health by waterway sanitation and improved waste treatment.

FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSOCIATIONS

Actual presentation of the plaque in Bonn was made in behalf of Mr. George W. Martin, President of the Federation, by Dr. Harold A. Thomas, Jr., Professor of Sanitary Engineering at Harvard University.

Dr. Imhoff's creative work in sanitary engineering is in itself a monument to him. His invention of the "Imhoff" tank about 1907 brought him wide recognition for this great advancement in sewage treatment. His years since have been completely devoted to improved sanitation through treatment of sewage and industrial wastes. The Federation is greatly indebted to him because U. S. royalties from his invention impounded during the First World War later became initial operating funds of the Federation.

Dr. Imhoff's early engineering training was in German Institutes of Technology at Karlsruhe and Munchen. In 1905 he received the degree of Doktor Ingenieur (Doctor of Engineering) from the Institute of Technology at Dresden. Later he was awarded Honorary Dr. Ing. degrees by the Institute of Technology at Karlsruhe (1930), Aachen (1949) and Stuttgart (1951). His engineering work included the position of Scientific Engineer for the Institute for Water Supply and Sewage Purification in Berlin and Engineer of the Emschergenossenschaft in Essen for 14 years. Partly concurrent with this assignment, he served as Engineer and Director of the Ruhrverband in Essen. In 1934 he resigned this position to devote his full time to consulting practice, which he has continued actively since that time.

Dr. Imhoff is well known for his many writings and books. His Taschenbuch Der Stadtentwasserung (Handbook of Municipal Drainage) appeared this year in its 16th Edition. This book was originally published fifty years ago primarily as a guide for the younger engineers of the Emschergenossenschaft. Its purpose was to give these engineers the fundamentals of the subject in a concise form and in the simplest language. Other books include *The Arithmetic of Sewage Treatment Works* (1929) and *Sewage Treatment* (1940) both coauthored by Dr. Gordon M. Fair of Harvard University.

In addition to his Honorary Membership in the Federation of Sewage and Industrial Wastes Associations (1953), he is an Honorary Member of four of the five Federation Member Associations in Europe. They are: Abwassertechnische Vereinigung (Germany), Verband Schweizerischer Abwasserfachleute (Switzerland), Institution of Public Health Engineers and Institute of Sewage Purification (England).

[Ed Note: The photograph of the bronze plaque does not do it justice. We are consequently not reproducing it here.]

"You can never stub your toe standing still. The faster you move, the greater the chance of stubbing your toe; but, the more the chance you have of getting somewhere"—*Charles F. Kettering.*

How About a Vacation ?

An open letter from one superintendent to another

Dear Bill,

Have you planned your vacation for this year? More importantly, have you taken last year's vacation yet? If I know you and remember rightly, you haven't taken a real vacation in years. Did you ever stop to think why?

I'm well aware of the fact that as superintendent of both water and sewage works, you have your hands full. I know too well that managing both water supply and sewage treatment is a continuous job — 24 hours a day, 7 days a week; 4 plus weeks a month, 12 months a year. Until we get that fully automatic plant we were talking about, there must always be someone either on the job or within hailing distance if anything goes wrong. So how can you take a vacation, you say?

In the past thirty-five years, I've met many fellows in our business who said they just couldn't get away for a real vacation, or even for a few days at a time. When I broke into this water works business, we worked 12 hour shifts, every day of every year. No vacations for anybody. Then we went to eight hour shifts, seven days a week, then came vacations, then the six day week, and now some have a five day week. That was fine for the shift operators etc., but still many superintendents "just couldn't get away" — Well that's mostly their own idea!

The Good Executive

Any superintendent worth his salt today, that can't find time to get away is a poor manager. I was reading the other day that an executive should realize that he couldn't do everything himself. He had to learn how to delegate responsibility and authority. Unless he does know how to do that, he is not a good manager. Why should a water works superintendent be anything but a good manager? Answer me that! And there are several reasons why a man should take a vacation, besides showing good management.

When President Eisenhower was laid low with a heart attact, there was a rash of advice from the medicos, psuedo-medicos, and just plain folks, all to the effect — "Pace yourself — Don't overdo!" And while there is professional disagreement as to the cause of heart attacks — whether it's the stress of modern business or too much fat in the diet, all professional and non-professional writers on the subject say that, just as a man needs rest and recreation daily, he needs complete respite from his labors not less than once a year, if not oftener.

Yessir, whether heart attacks and ulcers result from worry and strain may be a moot question, but modern medicine does know that no man can keep at top efficiency year after year without some change of scenery, activity, and interest occasionally. So, who am I to preach to you. — Well, in recent years I think I've come to some sensible attitude in this regard and I think it's about time you did too.

Convention Attendance

Until several years ago, I never left town for any reason. Always felt I had to be near enough to be on call at any time. Then someone got me to join the Association and I started going to the sectional meetings, but I always hurried there and back.

Then I started going to the National meetings as well and was gone from the plant for several days at a time. Nothing happened. Then one year, because my wife wanted to take a trip, we went on the special tour before and after the national meeting. So, at last I took a vacation, although it "kinda" sneaked up on me and was really related to business. I must admit, I thoroughly enjoyed the trip and the company of fellow workers in the field.

When I got home, though, I said to myself, "If I can be gone that long" on a combined business-pleasure trip, why can't I take a regular vacation, go away and forget the business?" So, I began to plan.

A Vacation Plan

To begin with, I got some business statistics together on the vacation programs of big business concerns. Then I held a meeting with my staff and discussed the matter. Next, I went to our Board and got approval for graded vacations on the basis of length of service.

Less than 6 months - 2 days next to some holiday

6 to 12 months - 5 working days in succession

1 to 10 years - 10 working days in succession

10 to 20 years - 12 working days in succession

20 to 30 years - 15 working days in succession

This schedule rewards the longer term employees. It also makes it possible for a man to have from 9 to 22 days away from the job depending on length of service. If a holiday falls in the period it extends the vacation to from 10 to 23 days. We allow eight holidays a year (New Year, Washington's Birthday, Decoration Day, Independence Day, Labor Day, Columbus Day, Thanksgiving and Christmas). Therefore, a man can schedule his vacation almost any month and get the benefit of the extra holiday.

Also we set up the rule that any employee of over ten years could split his vacation into two parts but not closer than four months apart. By this arrangement a ten year man can get two vacations a year of 10 days each away from the job. While a 20 year man can have one 14 day period and one 9 day period away from the job; with a holiday at either end he can add one day to each period.

Our office works a five day week, Monday through Friday, and the shift operators a 40 hour week on rotation, so you can see how these time periods work out. In the choice of vacation periods, we go strictly according to seniority, but many of the men switch among themselves in order to meet personal desires.

Delegation of Authority

In order to adopt this system we had to employ a couple of extra men, but we feel the cost is well worth the added expense in efficiency of operation. One other thing I had to do was draw up a flow diagram of delegated authority and responsibility. Of course, I have an assistant, who has complete authority when I am away. Where department heads have assistants, delegation of authority and responsibility is complete when the head is away. Of course, we try not to have more than one department head away at a time.

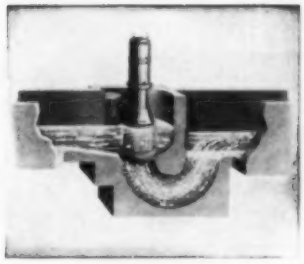
Now that our system is set up and functioning, I'm taking two vacations a year, one week after the national meeting and two weeks in the winter — why don't you?

Yours, Ted

"CHICAGO"

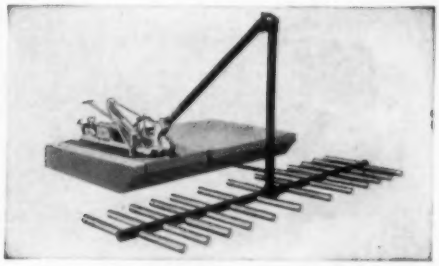
Your One Source of Supply for "KEY" Sewage Treatment Equipment

Displayed on this page are some of the better known processes and equipment for sewage and industrial waste treatment developed and introduced by Chicago Pump Company since 1930. Engineered to meet specific problems of sewage treatment, they represent the widest line of treatment equipment available—for comminution, grit removal, aeration, digestion and pumping.

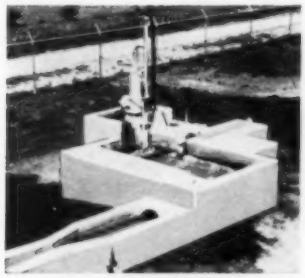


COMMINUTOR

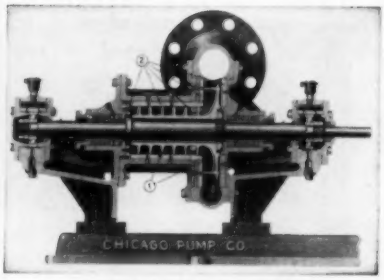
BARMINUTOR



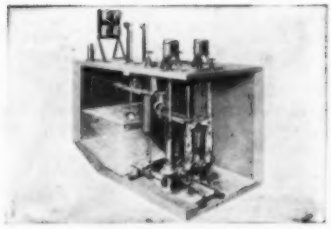
SWING DIFFUSERS



AER-DEGRITTER



SCRU-PELLER PUMP



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also

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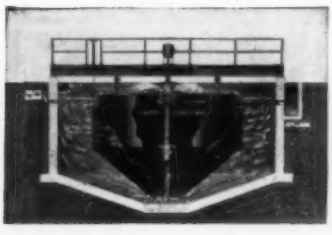
- CHICAGO-SELAS SLUDGE HEATER
- CATALYTIC REDUCTION PROCESS
- CHICAGO-WIGGINS LODEK COVER
- CHICAGO STANDARDAIRE BLOWER



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Flush Kleen ®, Scru-Peller ®, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers . . Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Barminutor ®, Comminutors.

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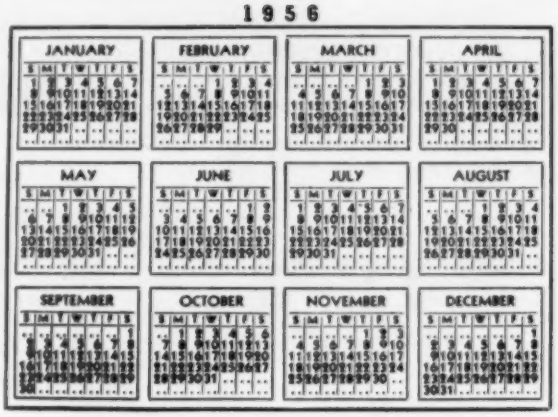
W&SW

Meetings Scheduled

1956



June 4-6—Auburn, Alabama (*Ala. Polytechnic Institute*)
ALABAMA WATER & SEWAGE ASSN., W. L. Samuel, Secy., Byrd L. Moore & Co., Box 143, Fairhope, Ala.

June 4-8—Knoxville, Tenn. (*University of Tennessee*)
AMERICAN SOCIETY CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 West 39th St., New York 18, N. Y.

June 5—New Milford, N. J. (*Hackensack Water Company*)
NEW JERSEY SECTION, A.W.W.A., Plant Inspection and Spring Outing. Secy., C. B. Tygert, Box 178, Newark, N. J.

June 5—Bloomington, Ill.
ILLINOIS WATER PLANT OPERATORS' CONFERENCE, Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.

June 7—Storrs, Connecticut (*University of Conn.*)
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Henry F. Munroe, Secy.-Treas., 75 Paine Ave., Cranston 10, R. I.

June 13—Boothbay Harbor, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

June 13-15—Cleveland, Ohio (*Carter Hotel*)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE (*30th Annual Meeting*) Ward E. Conrad, Secy.-Treas., 301 Ohio Depts. Building, Columbus 15, Ohio.

June 17-22—Atlantic City, N. J. (*Chalfonte Haddon Hall*) ....
AMER. SOC. FOR TESTING MATERIALS, Asst. Secy., Fred F. Van Atta, 1916 Race St., Philadelphia, Pa.

June 18-22—Meriden, N. H. (*Kimball Union Academy*)
GORDON RESEARCH CONFERENCE ON STREAM SANITATION, W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I.

June 20-22—Green Bay, Wisconsin (*Northland Hotel*)
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Geo. F. Bernauer, Secy.-Treas., 713 Chapman Street, Madison, Wis.

July 25—Freeport, Ill.
ILLINOIS WATER PLANT OPERATORS' CONFERENCE, Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.

(*Continued on page 88A*)

1 COILFILTER Replaces 2 Cloth Filters at Conshohocken, Penna.

The sewage treatment plant at Conshohocken, Penna. was originally a primary treatment plant employing two 100 Sq. Ft. cloth type filters for sludge dewatering. In 1954, when the plant was enlarged to include secondary treatment, these filters were replaced by *one* 100 Sq. Ft. Komline-Sanderson permanent filter media COILFILTER, dewatering digested primary and activated sludge. One COILFILTER is now substantially outperforming the record of two cloth filters—at a saving in overall power requirements, labor, maintenance, operating time and chemical consumption. Population served 12,200. Average flow .850 MGD

Clarence H. Cooper,
Conshohocken Plant Superintendent, says:

"The application of the Coilfilter to our particular plant has resulted in outstanding performance. This unit replaces two old style cloth type filters whose operation and maintenance costs were entirely unsatisfactory. We feel the Coilfilter embraces truly sound design and exceptional performance, a combination that reflects in a savings of chemical usage and maintenance costs. We are always proud to demonstrate the efficient operation of the Coilfilter and feel your unit has contributed greatly to the overall success of our entire operation".

Engineers: Albright & Friel

At right are shown three views of the Conshohocken Coilfilter

Write for Bulletin No. 103

KOMLINE-SANDERSON ENGINEERING CORPORATION

Peapack, New Jersey

Manufacturers of
COILFILTER Sludge Vacuum Filters

Star Performers on Important Duties

AURORA® Non-Clog Pumps, both Vertical and Horizontal have won high favor

— for industrial by-products, semi-solids, wastes, municipal sewage plants, lift stations, buildings and all duties involving the handling of heavy liquids and liquids containing solids.
AURORA always PUMPS
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Write TODAY for CONDENSED CATALOG "M"
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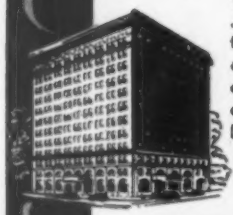

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Aug. 8—Kennebunk, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Aug. 27-29—University Park, Pa. (*Pennsylvania State Univ.*)
PENNA. WATER WORKS OPERATOR'S ASSN., Secy., R. Rupert Kountz, Dept. San. Eng., Penna. State Univ., University Park, Pa.

August 29-31—University Park, Pa. (*Pennsylvania State Univ.*)
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, 916 Diamond, Meadville, Pa.

Sept. 5-7—Clear Lake, Iowa (*P. M. Park*)
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., L. F. Skorczeski, Secy.-Treas. 207 South 15th Avenue, Marshalltown, Iowa.

Sept. 9-12—Pittsburgh, Pa. (*Wm. Penn Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, F. J. Van Antwerpen, 25 West 45th St., New York 36, N. Y.

Sept. 12-14—Bolton Landing, Lake George, N. Y. (*Sagamore Inn*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 12-14—Flint, Michigan (*Durant Hotel*)
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Mich. Dept. of Health, Lansing 4, Mich.

Sept. 12-14—St. Paul, Minn. (*Lowry Hotel*)
NORTH CENTRAL SECTION A.W.W.A., Secy., Leonard N. Thompson, Gen. Manager, Water Dept., St. Paul 2, Minn.

Sept. 16-19—Bretton Woods, N. H. (*Mt. Washington Hotel*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 17-19—Chattanooga, Tenn. (*Hotel Patten*)
KENTUCKY-TENN. SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell Engrs., 533 S. Limestone St., Lexington, Ky. and KENTUCKY-TENN. INDUSTRIAL WASTES & SEWAGE WORKS ASSN., S. Leary Jones, Secy.-Treas., Cordell Hull Building, Nashville, Tenn.

Sept. 19-21—Atlanta, Georgia (*Georgia Tech.*)
GEORGIA WATER & SEWAGE ASSN., 25th Annual Georgia Water & Sewage School, Georgia Institute of Technology, A. T. Storey, Secy.-Treas., 1210 Hemphill Ave., N. W., Atlanta, Ga.

Sept. 19-21—Toledo, Ohio (*Commodore Perry Hotel*)
OHIO SECTION, A.W.W.A., Secy., M. E. Druly, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio.

Sept. 19-21—Aberdeen, So. Dakota (*Hotel to be Announced*)
SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Charles E. Carl, Secy.-Treas., Div. of San. Eng., State Board of Health, Pierre, So. Dak.

Sept. 23-26—Fort Worth, Texas (*Texas Hotel*)
AMERICAN PUBLIC WORKS ASSN., (Public Works Congress), Robert D. Bugher, Asst. Director, 1313 E. 60th St., Chicago 37, Ill.

Sept. 26-28—LaCrosse, Wisconsin (*Stoddard Hotel*)
WISCONSIN SECTION, A.W.W.A., Leon A. Smith, Supt. Water and Sewage, City Hall, Madison 3, Wisconsin.

Sept. 30-Oct. 1, 2—Jefferson City, Missouri (*Hotel Governor*)
MISSOURI SECTION, A.W.W.A., and
MISSOURI WATER & SEWAGE CONFERENCE, Warren A. Kramer, Secy.-Treas., Division of Health, Jefferson City, Missouri.

Oct. 2-3—Springfield, Illinois (*Leland Hotel*)
ILLINOIS WATER PLANT OPERATORS' CONFERENCE Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.

Oct. 3-5—Mandan, No. Dakota (*Lewis & Clark Hotel*)
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Jerome H. Svore, Secy.-Treas., % State Dept. of Health, Bismarck, N. Dakota.

Oct. 4-6—Boise, Idaho (*Hotel Boise*)
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., W. W. Saxton, Secy.-Treas., 408 Old Capitol Bldg., Olympia.

Oct. 8-11—Los Angeles, Calif. (*Hotel Statler*)
FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSNS., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N.W., Washington 16, D. C.

Oct. 10—Caribou, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Oct. 14-17—Little Rock, Arkansas (*Marion Hotel*)
SOUTHWEST SECTION, A.W.W.A., Secy., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 15-16—St. John, New Brunswick (*Admiral Beatty Hotel*)
MARITIME BRANCH, CANADIAN SECTION, A.W.W.A., J. D. Kline, Secy.-Treas., Public Service Comm., P.O. Box 608, Halifax, N. S.

Oct. 15-19—Pittsburgh, Pa. (*Wm. Penn Hotel*)
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th St., New York 18, N. Y.

Oct. 18-20—Atlantic City, N. J. (*Hotel Madison*)
NEW JERSEY SECTION, A.W.W.A., Secy., C. B. Tygert, Box 178, Newark 1, N. J.

Oct. 21-24—Mobile, Alabama (*Battlehouse Hotel*)
ALABAMA-MISSISSIPPI SECTION, A.W.W.A., Secy., Charles W. White, State Dept. Public Health, 537 Dexter Ave., Montgomery, Ala.

Oct. 23-26—San Diego, Calif. (*U. S. Grant Hotel*)
CALIFORNIA SECTION, A.W.W.A., H. J. Ongerth, Secy.-Treas., 2151 Berkeley Way, Berkeley, Calif.

Oct. 24-26—Des Moines, Iowa (*Hotel Fort Des Moines*)
IOWA SECTION, A.W.W.A., Secy., J. J. Hail, Sup. of Water, City Hall, Dubuque, Iowa.

Oct. 24-26—Baltimore, Maryland (*Sheraton Belvedere*)
CHESAPEAKE SECTION, A.W.W.A., Secy., Carl J. Lauter, 6955 33rd Street, Washington 15, D. C.

Oct. 29-31—Windsor, Ontario (*Prince Edward Hotel*)
THE CANADIAN INSTITUTE ON SEWAGE & SANITATION, A. E. Berry, Secy.-Treas., Ontario Dept. of Health, Parliament Bldg., Toronto, Canada.

Oct. 31-Nov. 1-2—Bluefield, W. V. (*West Virginia Hotel*)
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Engr., W. Va., Water Service Co., Charleston, W. Va., and WEST VIRGINIA & INDUSTRIAL WASTES ASSN., G. O. Fortney, Secy.-Treas., State Health Dept., Charleston 5, W. Va.

Nov. 1-2—Omaha, Nebraska (*Castle Hotel*)
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSN., V. J. Lechtenberg, Secy.-Treas., 614 Standard Oil Bldg., Omaha, Neb.

Nov. 7-9—Old Point Comfort, Virginia (*Chamberlin Hotel*)
VIRGINIA SECTION, A.W.W.A., Secy., J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 11-14—Daytona Beach, Fla. (*Daytona Plaza Hotel*)
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSN., M. E. Dawkins, Secy.-Treas., % Reynolds, Smith & Hills, P.O. Box 4817, Jacksonville 1, Fla.

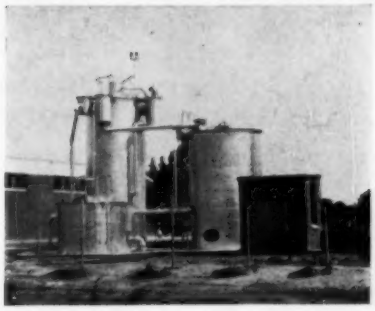
Nov. 12-14—Charlotte, N. C. (*Hotel Charlotte*)
NORTH CAROLINA SECTION, A.W.W.A., and NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN., W. E. Long, Jr., Secy.-Treas., Box 2091, Raleigh, N. C.

Nov. 12-16—Atlantic City, N. J. (*Convention Hall*)
AMERICAN PUBLIC HEALTH ASSN., Secy., Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 26-28—Colorado Springs, Colo. (*Broadmoor Hotel*)
ROCKY MOUNTAIN SECTION, A.W.W.A., Jack W. Davis, Secy., Johns-Manville Sales Inc., Denver, Colorado.

Dec. 12—Pittsfield, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

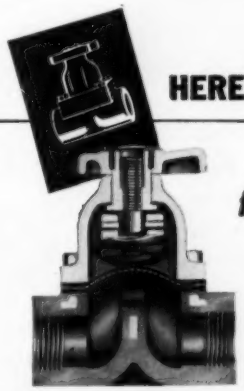
AN ALL STEEL
Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

Write for New
Spiragester Bulletin No. 135

LAKESIDE ENGINEERING CORPORATION
222 West Adams Street • Chicago 6, Ill.



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for all-plastic piping systems

Choice of non-toxic, odorless, non-contaminating Ace Parian (polyethylene) or Ace Saran . . . handles most corrosive chemicals and ingredients. Diaphragm is rubber, neoprene or polyethylene. Bonnet assembly sealed from solution. Can be serviced without removing from line. Hills-McCanna, Saunders principle. All sizes ½" to 2", for 50 psi. at 77 deg. F. Ace also offers *eight* types of plastic and rubber pipe, many valves, pumps, etc.; write today.

ACE rubber and plastic processing equipment • SINCE 1852
AMERICAN HARD RUBBER COMPANY, 93 Worth St., New York 13, N. Y.

W&SW

Spillway

OVERFLOW FROM THE MAIN SECTION

American Water Works Co. Loses Long-Time Mgrs.

P. R. Lutton and C. E. Burlingame Pass

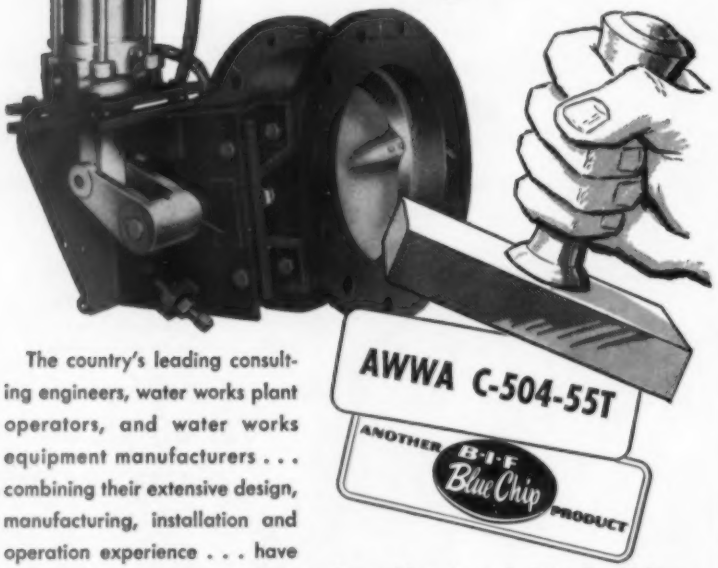
Percy R. Lutton, Manager of the Ellwood City, Pa., Water Company from January 1, 1928 until his retirement on May 31, 1955, passed away on April 3, 1956.

Prior to being employed by the Ellwood Consolidated Water Company as cashier on February 15, 1926, Mr. Lutton was proprietor of his own business and the manager of the A & P Tea Co. store in Ellwood City. He was a member of local civic clubs, the Ellwood City Chamber of Commerce, and a long-time member of the Pennsylvania Water Works Operators Association.

Charles Edwin Burlingame, Manager of the Berwick, Pa., Water Company passed away on April 2, 1956.

Employed by the Berwick Water Company as Assistant Cashier in 1915, Mr. Burlingame progressively held positions of Cashier, Acting Superintendent, Superintendent and Manager, which latter post he held for 25 years, from 1931 until his retirement in November 1955. He was a long-time member of the Pennsylvania Water Works Operator's Association, Kiwanis Club of Berwick, both the Pennsylvania State and Berwick Chambers of Commerce.

WHY BUILDERS Butterfly Valves ARE Better-buy Values!



The country's leading consulting engineers, water works plant operators, and water works equipment manufacturers . . . combining their extensive design, manufacturing, installation and operation experience . . . have prepared exacting specifications for rubber-seated Butterfly Valves. BUILDERS-PROVIDENCE Butterfly Valves conform to these specifications and offer the following superior features:

- √ Extra-rugged body construction.
- √ Extra large diameter, stainless steel shafts.
- √ Heavier, larger, longer bearings reduce unit bearing load.
- √ Heavier, sturdier vanes.
- √ Operators matched to valve . . . to meet job torque requirements and minimum AWWA Specs.

Builders Butterfly Valves fully comply with AWWA STANDARDS to make them BETTER-BUY VALUES. Request Bulletin 650-L1. Write to BUILDERS-PROVIDENCE, INC., 350 Harris Ave., Providence 1, R. I. . . . division of

B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND

BUILDERS-PROVIDENCE, INC. • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

$1,000,000 Valve Order for Two Philadelphia Water Plants

Two orders totaling "well over $1,000,000" for butterfly valves to be used in two municipal water filtration plants of the City of Philadelphia were recently announced by the Valve Division of S. Morgan Smith Co., York, Pa. The combined orders make this the largest butterfly valve order ever received by the firm, and one of the largest in this country.

Involved is a total of 295 rubber-seated AWWA standard butterfly valves ranging from 24 inches to 60 inches in size. They are to be used in Philadelphia's Torresdale and Queen Lane filtration plants. Delivery, to be spaced over a period of a year, will start the latter part of this summer.

The rebuilding project on the Queen Lane plant is divided into three contracts held by Laub Construction Co., Huffman-Wolfe Co., and Roberts Filter Manufacturing Co. Prime contract for the new Torresdale plant is held by McCloskey and Co.

San Diego Consolidates Sewers and Sewage Treatment

Effective July 1, 1956, there will no longer be the separate Divisions of Sewer and Sewage Treatment in the Department of Public Works of the City of San Diego. On that date the two Divisions will officially combined and thenceforth be known as the Sewerage Division.

Mr. Eric V. Quartly, who has been Superintendent of the Sewage Treatment Division in the Department

since 1943, will be the Superintendent of the new Sewerage Division. Mr. Leland Cook, Jr., will continue as Assistant Superintendent in charge of Sewage Treatment and Mr. Alfred F. Sotier will continue as Assistant Superintendent in charge of Sewer Maintenance.

Water Works Conference Formed in Western N. Y.

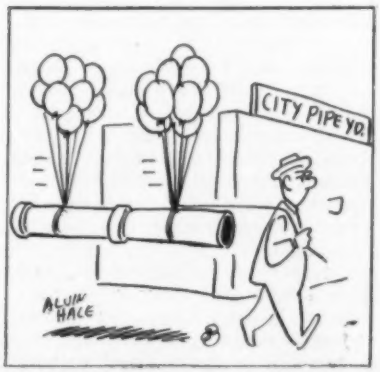
A new water works group was formed March 15 at Avon, N. Y., with the organization of the Western New York Water Works Conference. The initial meeting featured a round table discussion led by Donald Stearnes, consulting engineer of Cazenovia, N. Y.

Attendance of 135 at the first meeting included representatives of 57 water works, 5 engineering firms, 3 contracting companies, and 29 manufacturers' representatives.

Purpose of the new organization is to help the small water works operator with his problems and to get the small operator, large operator, and manufacturers together twice a year to discuss mutual problems.

Officers of the group are: President, Joseph O'Day, general manager of New York Water Service Corp. of Rochester; Vice-President, Duncan McNaughton, Superintendent of the Genessee Water Department; Secretary-Treasurer, Clifford Champion, Superintendent of the Sea Breeze Water Department.

Directors include: J. P. Emerson of U. S. Pipe & Foundry, Syracuse; Nelson Fuller, Superintendent, Water Department, Batavia; H. W. Moore, Neptune Meter Co., DeWitt; Frank Nehin, Hydraulic Engineer, City of Buffalo Water Department. R. E. Clark, of Warren Pipe & Foundry Co., Avon, is chairman of the program and arrangements committee.



"SUPER": I'll just show the boys that they can still lay pipe even if our only truck has broken down.

goes *anywhere* *the* **F&P**

Portable CHLORINATOR

Here's the answer to emergency or field construction chlorination—the Fischer & Porter *portable* chlorinator.

Readily moved by man or boy, it is a reliable stand-by chlorinator; anywhere, anytime. Can be conveniently transported by automobile, by airplane, or on foot to locations inaccessible to vehicles. Contractors find it indispensable for disinfecting new and old pipelines, municipalities use it for standby plant operation, emergency flood or field chlorination.

Employs the same rugged construction and safe, efficient, positive instrument-type controls used so successfully in the larger F&P chlorinators. Fully enclosed in tough, light Fiberglas cabinet, the entire unit is impervious to corrosion. Weighs less than forty pounds. Write today for complete information.

- **SAFETY**—built-in positive acting safety devices.
- **SIMPLICITY**—does not require highly skilled personnel to operate.
- **MAINTENANCE-FREE**—constructed entirely of materials inert to corrosion by dry or wet chlorine.
- **WIDE RANGE**—standard 10 to 1 overlapping flow ranges from 0.1 to 1000 PPD chlorine.
- **EASY TO CHANGE CAPACITY**—Converts to higher or lower flow ranges in minutes without special tools.

FP FISCHER & PORTER COMPANY

166 FISCHER ROAD, HATBORO, PENNA.

FISCHER & PORTER CO.
756 Fischer Road, Hatboro, Pa.

Please send complete information on your portable chlorinator.

Name_____ Title_____

Organization_____

Address_____

City_____ State_____

W&SW

New Equipment

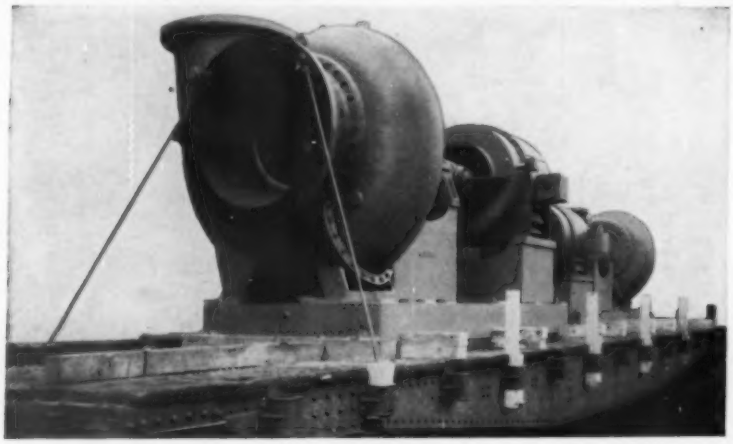
Four New Defoamers Developed For Sewage And Industrial Wastes

601

Swift & Co., Industrial Oil Department, Hammond, Ind., has developed a new line of defoamers for use in activated sludge plants and on industrial wastes.

Available in four grades for a variety of uses, the new products are, say Swift & Co., effective when used in concentrations as low as 1 part per million.

Several methods of applications, revealed during development work on the new defoamers are: (1) Defoamer may be added directly to the aeration tanks, by dripping—from drum or other container. (2) It may be pumped through a system of tubing to a large number of aeration tanks. (3) It may be mixed with a water spray system where additional foam control is necessary. And (4) it can, in some systems, be added to the influent channel to control foam by addition at one point only.



THESE WHEELER-ECONOMY PUMPS HOLD CONSTANT LEVELS IN THE NEW TRICKLING FILTERS AT DALLAS' WHITE ROCK PLANT

Two of the Wheeler-Economy pumps installed in the White Rock Sewage Treatment Plant for Dallas, Texas are believed to be the largest ever operated through magnetic couplings. In order to maintain constant levels in the suction wells and grit channels, each of the two units driven through magnetic couplings are governed by an elaborate float level control. This helps the big Wheeler-Economy pumps to maintain level within predetermined 6" limitations. Total pumping capacity of the four Wheeler-Economy pumps installed at the White Rock Plant is 134 million gallons a day.

Rely on Wheeler-Economy for help in complex pumping problems,

WHEELER-ECONOMY HORIZONTAL, MIXED FLOW RAW SEWAGE PUMPS AT INSTALLATION

dependable delivery and performance that lives up to promise.

Wheeler-Economy Pumps in Operation at Dallas' White Rock Plant

- 24" suction x 24" discharge variable speed pump driven through magnetic coupling by a 250 HP, 2300 volt horizontal electric motor. Capacity 20,000 gallons per minute at 40' total dynamic head.
- 24" x 20" variable speed pump, driven through magnetic coupling by 200 HP, 2300 volt motor. Capacity 13,000 GPM at 40' TDH.
- 42" x 36" constant speed pump, driven by 400 HP, 2300 volt motor. Capacity 40,000 GPM at 37' TDH.
- 24" x 20" constant speed pump, driven by 200 HP, 2300 volt motor. Capacity 20,000 GPM at 37' TDH.

WKS28

WHEELER-ECONOMY PUMPS

ECONOMY PUMPS, INC. - DIVISION OF C. H. WHEELER MANUFACTURING CO.
19TH AND LEHIGH, PHILADELPHIA 32, PA.

The New and Improved "METER-MASTER"

602

The F. S. Brainard Company of Hartford, Conn. has announced the introduction of a new, improved model of the "Meter-Master", standard rate recorder for water meters. This argument saving instrument, used by water works throughout the world for more than twenty years, has been completely redesigned to incorporate many features that improve performance, accuracy and ease of handling.

Conceived and designed by Frank S. Brainard, while Supt. of Distribution at Hartford, Conn., the "Meter-Master" has many applications. It is principally used for detecting presence of hidden leaks, wasteful water use practices, spotting fixtures using more water than they should, and for

determining correct meter sizes—thus reducing slippage in oversize meters at low flows. It is of particular value in handling high bill complaints, by supplying a documented chart record of actual and (to the customer) often surprising water usage.

The new 1956 model "Meter-Master" can be attached to *any* meter—single or compound—in three minutes, and automatically charts the time of the flow (night and day) and rate during each period of flow, thus presenting a permanent and irrefutable record of the use of water for that particular service.

While recording the flow, the "Meter-Master" does not interrupt the operation of the meter nor obstruct the dial. It operates mechanically without use of power.

Greater accuracy has been effected in the new model by elimination of the flexible shafts of the earlier models. The instrument can now be attached directly to the meter pointer (see cut).

The universal coupling kit supplied makes it possible to fit any size or type meter. When connected to a compound meter, the instrument simultaneously records the flow through both sides on a single chart.

The instrument is assembled completely of aluminum and brass, now weighing only seven pounds. It comes equipped with a lock and complete kit for attaching to any meter. Only a screw driver is required for the three-minute application.

The "Meter-Master" (referred to by operators as the "G-man of the Waterworks Industry") can be adjusted to record five periods of time—two hours, six hours, twenty-four hours, seventy-two hours and seven days. All these chart speeds are available.

Plastic Pipe

603

American Hard Rubber Co., New York, N. Y., has announced Rivichlor, a new rigid pipe extruded of a special high-strength polyvinyl chloride compound that offers an unusual combination of chemical resistance, high bursting strength, and toughness. Impact strength is as high as 2.5 (Izod), and the material remains tough and non-brittle even at sub-zero temperatures. This factor makes Rivichlor easier to cut, thread and assemble without breakage or damage, and enables Rivichlor pipe and fittings to withstand considerable mechanical abuse.

The new pipe is non-toxic, inert,

(*Continued on page 94A*)

A grain elevator gets a good going over, *INSIDE, OUTSIDE!*

COMPLETE BREAK-THROUGH IN WALL

How to save this costly structure, without rebuilding sections, presented a serious problem.

Workmen on scaffolds, from inside and outside, cut out deteriorated concrete.

Necessity of costly forming was eliminated by the use of THORITE 20-minute set, nonshrink, filling and patching mortar.

THORITE

THORITE permits completion of job in one fall of scaffold, followed immediately by THOROSEAL seal coat.

Air hammers cut away loose and crumbling concrete. THORITE formed into cleaned-out sections, with a minimum labor cost, restored elevators to original condition.

Job completed with the application of THOROSEAL over entire structure.

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STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PA. • CENTERVILLE, IND.

odorless and tasteless, and can be specified for many food and beverage ingredients. Since it is an excellent electrical insulator, nonflammable, and self-extinguishing, it can also be used in many hazardous locations.

Automatic Control For Vari-Speed Motodrives

604

Reeves Division, Reliance Electric and Engineering Company, Columbus, Ind., has announced the availability of a new automatic control for their fractional series of Vari-Speed Motodrives.

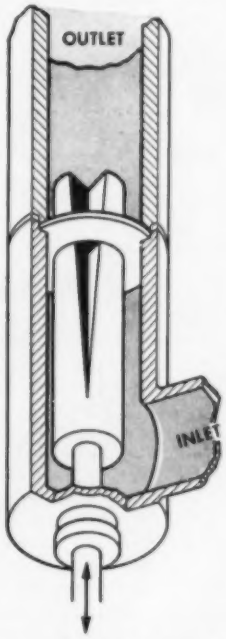
This control is actuated from any pneumatic instrument that gives signals of 3-15 psi air pressure which operates an air piston through valving to control the lateral movement of the speed changing mechanism, and in turn the output speed of the variable speed drive.

Its principle use is in continuous processing applications where the drive speed is required to automatically vary in accordance with changes in liquid level, pressure, temperature, flow, weight, position, color, etc. A compensating feature has been built into the controller to secure a true linear relation between changes in input air pressure and variable output speed.

V-Notch Variable-Orifice For Chlorinator Control System

605

Wallace & Tiernan Inc., Belleville, N. J., has developed the V-notch Variable-Orifice as the heart of a new chlorinator control system. With the system, a constant differential vacuum is maintained across the V-notch Variable-Orifice and the flow of chlorine gas is adjusted by varying the area of the orifice.

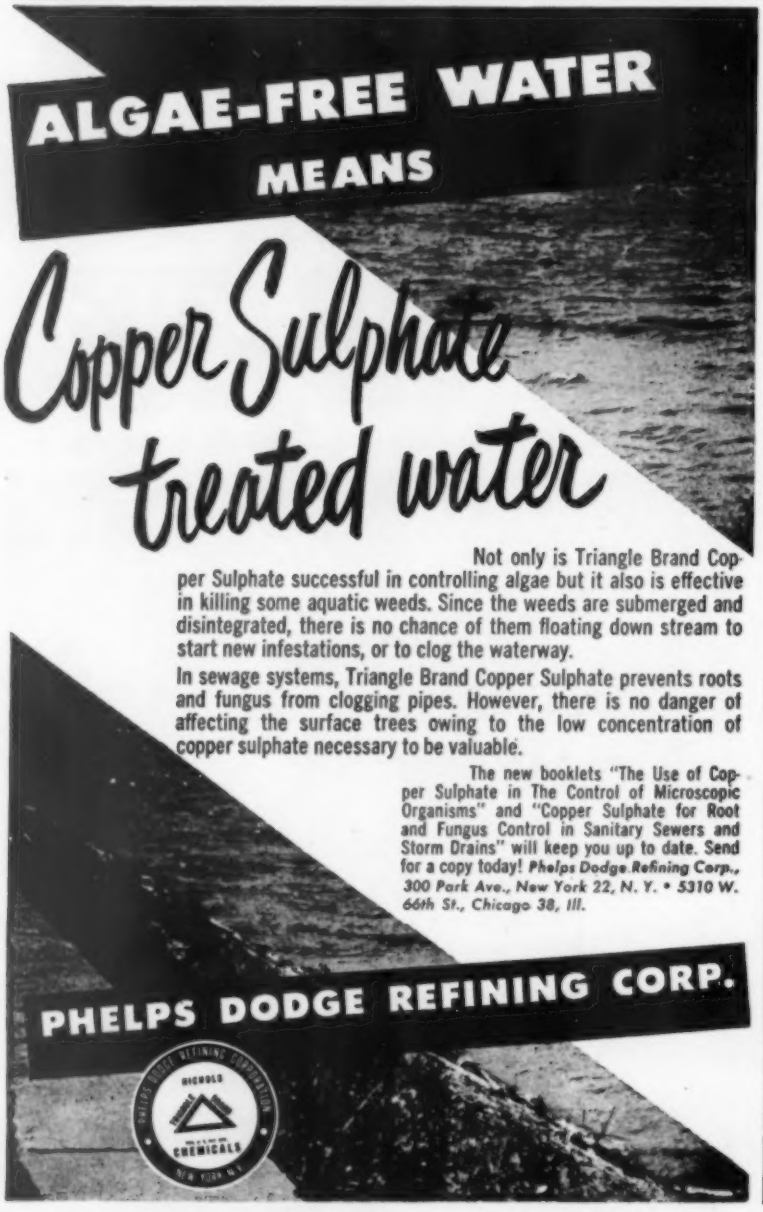


The V-notch Variable-Orifice is formed by a cylindrical plug positioned inside a matched, circular ring. A V-shaped groove is machined along the length of the plug. The groove starts near one end of the plug and gradually enlarges to its maximum width and depth at the other end of the plug. The V-notch orifice is formed at the intersection of the grooved plug and the matched ring. The orifice area is varied simply and positively by positioning the plug backward or forward inside the fixed ring.

Cast Iron Gate Valve

606

Smith-Scott Company, Riverside, California, is now marketing a new low cost #125 IBBM type gate valve.


ALGAE-FREE WATER
MEANS
Copper Sulphate
treated water
Not only is Triangle Brand Copper Sulphate successful in controlling algae but it also is effective in killing some aquatic weeds. Since the weeds are submerged and disintegrated, there is no chance of them floating down stream to start new infestations, or to clog the waterway.
In sewage systems, Triangle Brand Copper Sulphate prevents roots and fungus from clogging pipes. However, there is no danger of affecting the surface trees owing to the low concentration of copper sulphate necessary to be valuable.
The new booklets "The Use of Copper Sulphate in The Control of Microscopic Organisms" and "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains" will keep you up to date. Send for a copy today! Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y. • 5310 W. 66th St., Chicago 38, Ill.
PHELPS DODGE REFINING CORP.
CHEMICALS

The new valve has a cast iron body and bronze mounted type gate valve with a non-rising stem. Screw type valves with standard 8-V thread are available from 2½" to 8" pipe sizes, and Flange Type Valves with standard face and drilling, are available from 2½" to 12".

While the valve is low in cost, it is reported to be more than adequate for water pressures encountered in the usual irrigation system or domestic water lines.

New Device Tests Water Meters In Place

607

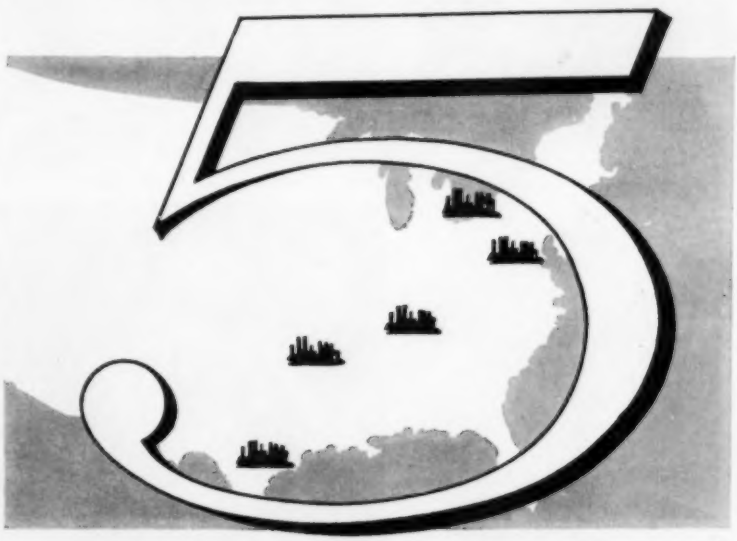
The H. E. Anderson Co., Muskogee, Okla., has announced full production of the Chart-A-Meter.

The Chart-A-Meter is a simple device, easily attached to water meters that graphically portrays the time and flow of water through any given meter installation. A compact precision instrument, measuring 6¾ inches in diameter and 4½ inches in height, it is simple to install—just remove the meter register and attach Chart-A-Meter in its place. The device will fit any make or size water meter through the use of adapter plates. The adapter plate is held in place by two knurled screws. The gear from the meter register is then placed on the shaft of the Chart-A-Meter which in turn fits into the rabbet where the register was removed. Installation takes less than five minutes, and water shut-off is not necessary.

The Chart-A-Meter uses charts made of specially coated paper which is marked by a stylus. This eliminates any chance of smearing. No special skill is needed. The chart is turned by an eight day wind clock, with twenty-four rotation chart drive.

CHEMICALS YOU LIVE BY

Diamond Chlorine



Conveniently Located Chlorine Plants

Looking for a reliable chlorine producer that can back you up in emergencies? Call DIAMOND ALKALI.

We are equipped to give you fast service from five conveniently located plants as well as technical help from one of the world's greatest stores of chlorine know-how.

Call your nearest DIAMOND sales office or plant for regular or emergency shipments.

FREE! CHLORINE SAFE-HANDLING WALL CHART

DIAMOND ALKALI's years of know-how have been compressed into this chlorine safe-handling wall chart. Hang it where workers can read it. Copies free. Ask your DIAMOND sales office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

DIAMOND ALKALI CHEMICALS

Diamond Chemicals

CHLORINE PLANTS: Edgewood, Md. — Houston, Texas — Muscle Shoals, Ala., Painesville, Ohio — Pine Bluff, Ark.

SALES OFFICES: Cleveland, Cincinnati, Chicago, Houston, Memphis, New York, Philadelphia, Pittsburgh, St. Louis

• **If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.**

Power Unit For Electric Eel Sewer And Wasteline Cleaners

608

The Ohio Tool and Engineering Co., Springfield, Ohio, has developed a new power unit that is now being furnished on all Electric Eel sewer and wasteline cleaning machines.

The unit weighs less than any previous model (only 49 pounds)—yet develops even greater power. The starting winding has been so developed that the unit may be plugged into an ordinary house circuit—although the running winding has been stepped-up to almost ¾ H. P. The motor is electrically reversible and the starting switch has been proven, under vigorous field testing, to be absolutely reliable.

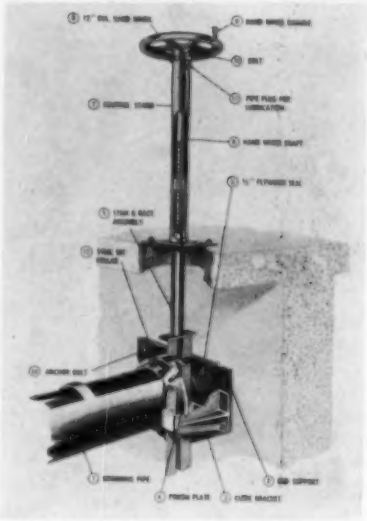
New Packaging Plan For Peerless Pumps

Peerless Pump Div., Food Machinery & Chemical Corp., Los Angeles, Calif., has announced that easy stocking, easy storing, easy ordering and easy application are the multiple benefits of a new, end-suction pump packaging plan.

From over 50 different face-mount and close-coupled pump sizes available, surveys by company sales engineers indicated that 22 pump models, ranging from 1 to 15 hp, were the most popularly and regularly ordered sizes. Peerless Pump has now prepackaged these 22 job-sized pumps in reinforced cartons for easy stacking and storing under their "redi-pak" Fluidyne label.

Roto-Skim Scum Remover

609



Chain Belt Company, Milwaukee 1, Wis., has announced the production of a new Roto-Skim that is operated on the rack and pinion principle.

The Roto-Skim is a slotted pipe that removes scum from the surface of primary waste treatment tanks and recovers byproducts in API tanks. It is ideally suited to those primary waste treatment tanks where the freeboard is in excess of three feet, and where the cost of other skimmers is prohibitive. A handwheel activates the pinions which in turn control the rotation of the REX Roto-Skim pipe. The Rex rack and pinion Roto-Skim can be accurately adjusted to the liquid level to make

Champion Fire Fighters

COMPRESSION TYPE FIRE **HYDRANT**

M H

Above all else, M & H Fire Hydrants are reliable and dependable fire fighting equipment. They deliver when the need arises, if there is water in the mains. Their high flow efficiency is due to an unobstructed, large waterway which has the same diameter its entire length.

Dry top, dry barrel when not in use, eliminates danger of damage by freezing. Operating parts are bronze or bronze bushed. Easy to lubricate.

Manufactured according to A. W. W. A. standard specifications or Underwriters and Factory Mutuals approved; in conventional model, traffic model or flush-type model; sizes 4¼, 4½, 5¼ and 6¼. For complete information, address

M&H VALVE AND FITTINGS COMPANY
Anniston, Alabama

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

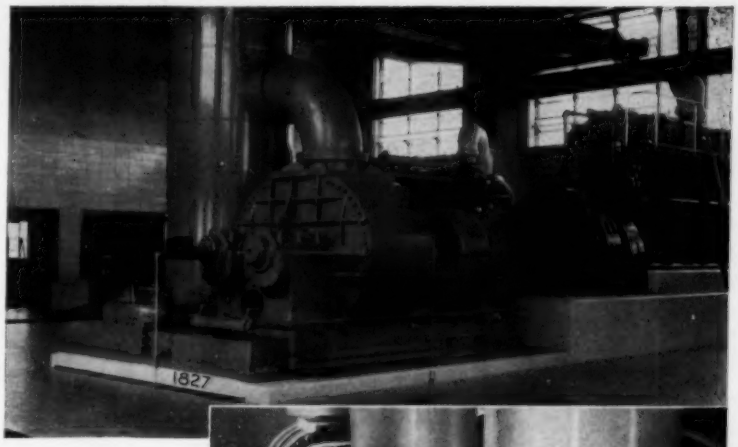
efficient skimming quick and simple.

Single-Column Spheroidal Water Towers Double Water Storage

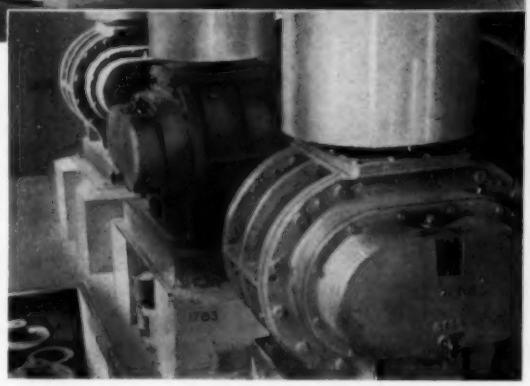
610

Chicago Bridge & Iron Co., Chicago, Ill., has announced the Waterspheroid—a new form and construction for streamlined elevated tanks—that extends the capacity of the graceful single-column water tower from the 250,000-gallon limit of the standard Watersphere up to 500,000 gallons. The new flattened sphere (spheroidal) shape permits use of larger tank sizes without excessive head range, the difference in height (and therefore delivery pressure) between high water and low water in the tank. The head range of the new 500,000-gallon Waterspheroid (59 ft in diameter) is, for example, only 30 ft, the same as the head range of a 150,000-gallon Watersphere (only 34 ft in diameter).

The principal benefits of the design include: (1) less land area needed; (2) less exposed surface (approximately two-thirds that of a conventional tank) with resultant savings in both heating cost and painting costs (3) graceful sweeping lines which fit in more beautifully with landscaping and natural surroundings; (4) wholly enclosed inspection-access; (5) the ability to house pumping and valving equipment within the flared base of the column; (6) total elimination of external ladders which invite children to climb; and (7) smooth surfaces from top to bottom without ledges or recesses where dirt can collect, corrosion set in or painting be slowed.



↑ One of two R-C Rotary Positive Blowers in large metropolitan sewage treatment plant. Capacity of each blower is 5,860 cfm.



In this rural southern community, three small R-C Blowers (capacity 350 cfm each) provide completely dependable performance. →

BIG CITIES AND SMALL TOWNS PROFIT FROM R-C *plur-ability*

Freedom from maintenance cost and completely dependable performance are two of the important factors which make up the "*plur-ability*" of Roots-Connersville Blowers for sewage treatment. Add to these the wide range of sizes and capacities . . . choice of Rotary Positive or Centrifugal types . . . extremely low operating cost . . . flexibility of drives . . . and capable engineering service in the selection of equipment.

These values account for the overwhelming choice of R-C Blowers and related equipment for public or industrial waste treatment. Ask for details for installations being planned or under consideration, and see why R-C *plur-ability* pays off in any size plant.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

156 Mount Ave., Connersville, Indiana. In Canada — 629 Adelaide St., W., Toronto, Ont.

W&SW

Manufacturers' News

Penn Instruments Appoints Two Representatives

Penn Instruments Division, Burgess-Manning Co., Philadelphia, Pa., has announced the appointment of Williams Equipment Co., Metairie, La,. and Frank E. Early Co., Detroit, Mich., as representatives of the company.

The Williams Equipment Company, Metairie, La., will represent Penn Instruments in the Louisiana and lower Mississippi area.

The Frank E. Early Co., 15028 Fenkell Ave., Detroit, Mich., will cover the state of Michigan for the municipal and industrial products of Penn Instrument Div.

Bonnett to Head New Pittsburgh Office of Roots-Connersville

Roots-Connersville Blower, Division of Dresser Industries, Inc., Connersville, Indiana, has established a Pittsburgh sales office in the Grant Building, Room 2411, Pittsburgh 19, Pennsylvania. Mr. Edward N. Bonnett will head the new office.

He will assume responsibility for the organization and management of the sales territory assigned to the Pittsburgh office, which includes western Pennsylvania and the northern counties of West Virginia.

Bonnett held the position of Assistant Sales Manager with The Stacey Brothers Gas Construction Company, Cincinnati, Ohio prior to joining Roots-Connersville in 1955. He completed a comprehensive training program for sales engineers at the Company's main plant and offices in Connersville. Following this program, he worked in the Cleveland, Detroit and Chicago offices and has spent the past few months in the Pittsburgh area.

Cooper-Bessemer Assigns Spetka To New York Office

The Cooper-Bessemer Corporation, Mount Vernon, Ohio, has announced the assignment of Richard L. Spetka to the New York Domestic Sales Office.

Mr. Spetka will assist in the engineering and sale of compressors and engines. His activities will be carried out under the direction of Charles M. Reagle, Vice President and District Manager, and George W. Edick, Branch Manager.

A graduate of Ohio State University, Mr. Spetka is a registered professional engineer and has previously spent 3 years with the U. S. Army Corps of Engineers.

Alco Products Promotes Ward

Alco Products, Inc., Schenectady, N. Y., has announced the ap-

SEWERODER UNPLUGGED IT...
...Before Ordinary Equipment Could Be Set Up!

To unplug sewers in "lakes" like this, just roll the SEWERODER up to the manhole — drop in Rod Guide, direct it into sewer pipe — and start the machine.

This mechanical robot rods — rotates and retracts — with no delay for connecting rods by hand.

SEWERODER's super speed enables your crew to clean many more sewers in the same emergency period — saves many a basement from flooding — reduces danger of contaminated water supply — and all at lower cost per foot.

FLEXIBLE INC.
3786 Durango Ave., Los Angeles 34, Calif.
(Distributors in Principal Cities)

Our representative in your territory will be glad to give you more facts. Or, write for FREE CATALOG 55-A.

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622	623	624	625	626	627	628
629	630	631	632	633	634	635

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE AND ITEM BELOW.

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for

WATER & SEWAGE WORKS

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READER SERVICE CARD for

WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

pointment of Thomas L. Ward as manager of the company's plant at Dunkirk, N. Y.

Ward has been with Alco since 1937. He joined the company in New York City as assistant chief estimator and later worked in the New York office as assistant chief engineer. In 1953 he was transferred to Dunkirk as executive engineer and a year later was appointed marketing manager of the plant. He was named manager of manufacturing services last September.

Holbert Promoted By H. K. Porter Co.

H. K. Porter Company, Inc., New York, N. Y. has announced that Charles L. Holbert has been appointed Executive Vice President. Mr. Holbert, who will be

operating head of Porter, succeeds Clarence R. Dobson who has retired.

Mr. Holbert came with Porter earlier this year as a Vice President. Before joining the company he was Executive Vice President of the Southern Pacific Milling Company, Ventura, California. Previously he was Vice President and General Manager of the Johnston Pump Co.

Polyken Tape To Build Million-Dollar Plant

The Kendall Co., Chicago, Ill., has announced that a new million-dollar plant for manufacturing its Polyken plastic film and plastic adhesive tape coatings for corrosion prevention will be erected on a 76-acre site in Franklin, Kentucky.

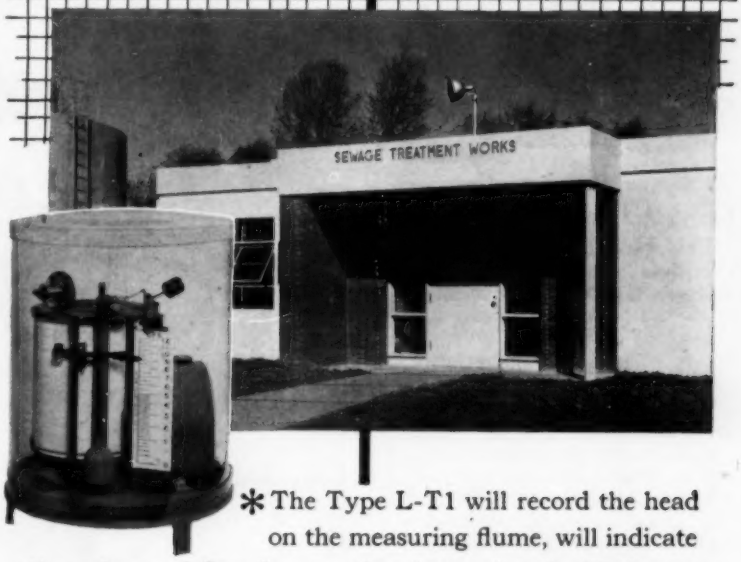
The initial unit will provide 35,000 square feet of floor space and will have air conditioning to control process work. Truck docks, located at each end of the building, will expedite the flow of raw materials and finished product. A siding will lead in from the Louisville and Nashville Railroad.

PROBLEM:

To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:

Stevens Type L-T1 Recorder*



*The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

STEVENS DATA BOOK

...invaluable for your reference file

144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

CONSULT WITH STEVENS INSTRUMENTATION SPECIALISTS

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. GLISAN STREET • PORTLAND 13, OREGON

Foremost in Precision Hydraulic Instruments Since 1907

W. L. Ogden, Lakeside V.P., is Dead

Willis L. Ogden, vice-president of Lakeside Engineering Corp. died on March 26, 1956 in Janesville, Wisconsin, after an illness of several weeks. He was only 33 years old.

Born and reared in Annawan, Ill., he was a graduate (B.S.) of the University of Illinois. He later took his M.S. degree in Sanitary Engineering from Howard University. During World War II he served in the U. S. Public Health Service. For the past three years, and better, he has been connected with the Lakeside Engineering Corp. of Chicago; and, at the time of his untimely passing at the age of 33 years, was a vice-president of Lakeside Engineering.

Six Crane Co. Executives Killed in Plane Crash

En-route to a convention in Louisville, Ky. six Crane Co. officials and the two plane pilots were all killed in the crash of the company twin-engine plane in sight of its destination. Cause of the crash in a rainstorm May 15 is not known at this writing. The following Crane executives were killed:

J. A. Dwyer, Vice-President
G. L. Erwin, Vice-President
J. A. McMurry, Director of Branches
C. Towner, Asst. Vice-President
G. G. Lindholm, Dept. Manager
F. J. Wilkey, Spe'l. Representative

The pilot and co-pilot were Randy Milherin and Bob Robinette.

Two Pipe Firms Join Forces to Produce Sewer Pipe of Special Design

Two large concrete pipe manufacturers have joined forces to produce a particular type of concrete pipe required by the Allegheny County Sanitary Authority in the $87,000,000 sewer project for the Pittsburgh, Pa. area.

In the joint venture are the Neville Concrete Pipe Co. of Neville Island, Pittsburgh and American Marietta Corp. of Chicago. The latter is the parent firm of Universal Concrete Pipe of Pittsburgh. The new pipe manufacturing plant on Neville Island, Pittsburgh is already under construction.

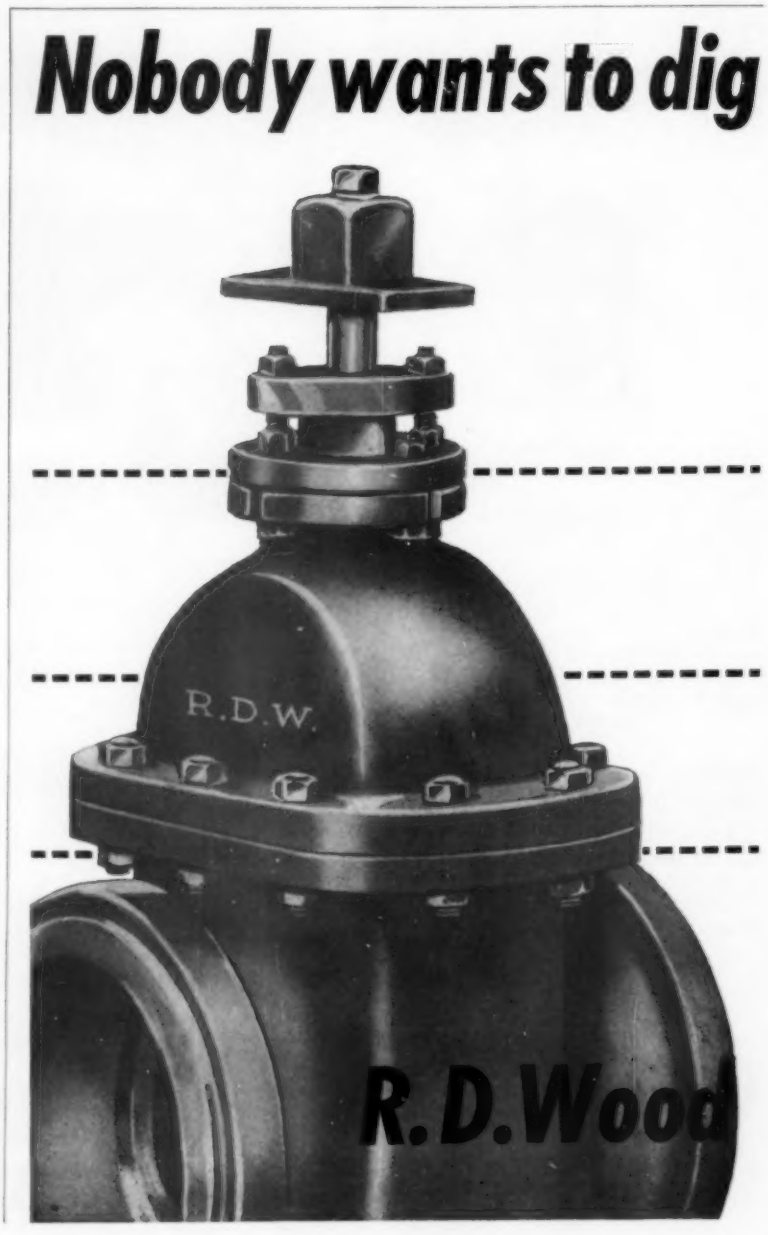
The special pipe of 66 inch diameter will be produced in 66 ft. lengths and is to be made to meet specifications of the Allegheny County Sanitary Authority. The special pipe differs from concrete pipe now available on the open market. More than 300,000 ft. of this pipe is needed for construction of some 63 miles of sewer contributory to the Wood's Run Sewage Treatment Plant of the Authority, for which ground was broken in April.

Chicago Bridge Elects Horton Chairman; Michaels, President

Chicago Bridge & Iron Company, Chicago, Illinois, has announced that Horace B. Horton has been elected Chairman of the Board. Mr. Horton joined the Company in 1907 and had been President since 1945.

Ernest E. Michaels, formerly Executive Vice President, succeeds Mr. Horton as President. Charles S. Pillsbury, formerly Vice President and Treasurer, was elected Vice President and Secretary, and Arthur B. Horton, formerly Assistant Treasurer, was elected Vice President and Treasurer.

George E. Borst, District Sales Manager of the New York Sales Office of Chicago Bridge & Iron Company, was elected Vice President.



Jeffrey Promotes Taylor

The Jeffrey Manufacturing Company, Columbus, Ohio, has announced that J. C. Price Taylor was appointed manager of Crusher and Pulverizer Sales.

Mr. Taylor has been sales engineer for that division in the East and has been with the company twenty years. He attended Lehigh University and is a World War II veteran.

It was also announced that Frank J. Hrabley, an Ohio State University graduate, has taken a position in Jeffrey's Advertising Department. He will have charge of direct mail activities which includes editing the company's internal house organ.

Presstite Engineering Joins Keysone Asphalt Products Co.

The Presstite Engineering Company, St. Louis, Mo., and Keystone Asphalt Products Company, Chicago, Ill., has announced a merger of the two companies under the name of Presstite-Keystone Products Company. The new company is a division of American-Marietta Company.

up gate valves

Reliability is the important consideration in gate valves. They have got to work and *keep on working* even after years of idleness in the lines. Digging them up for repairs is too costly—as well as a possible fire or health hazard while they are out of operation.

Nobody Need Dig Up This Gate Valve

The R. D. Wood Gate Valve is designed for severe underground service. It can be counted on to do what is expected of it for scores of years.

Simple in Design

The Wood Gate Valve is reliable, because there's nothing to go wrong. It is rugged, fully bronze mounted, suitable for working pressures up to 175 pounds.

Only Three Moving Parts

Just a spreader and two discs—no small wedges or delicate parts.

Revolving Discs

One of the secrets of Wood gate valve reliability is that the discs are hung loosely. They are free to revolve their complete circumference while being raised or lowered. There's no dragging of the faces to cause wear at one point.

Uninterrupted Flow

The fully opened valve provides unobstructed passage. Gates are lifted entirely clear of the valve openings.

Available with mechanical joint pipe connections

Company **Public Ledger Building, Independence Square**
Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

The personnel of both organizations will remain unchanged and all correspondence and contacts should be directed to the same address as used in the past.

C. H. Wheeler Elects Two Directors

C. H. Wheeler Manufacturing Co., Philadelphia, Pa., has announced the election of Clayton S. Coggeshall and Paul J. Doyle to the Board of Directors.

Mr. Coggeshall has served as marketing consultant to C. H. Wheeler for the past two years. He is a graduate of Cornell University with a degree in Mechanical Engineering. From 1911 he held various executive posts in General Electric Co.

Mr. Doyle is District Sales Manager of Carbide and Carbon Chemicals Company, Houston, Texas. He is also Treasurer of Carbonna, Inc., investments. He holds a bachelor of science degree from the University of Notre Dame, 1936.

Gould Joins Water Service Labs

Water Service Laboratories, Inc., New York, N. Y. has announced the appointment of Gregory Gould to the administrative engineering staff.

Mr. Gould was formerly secretary-treasurer and supervising engineer of Fuel Engineering Company of New York, with whom he had served since 1946.

Prior to the war years, during which time he served as a naval officer, Mr. Gould was associated with Wallace & Tiernan, Inc. He is an industrial engineering graduate of Lehigh University.

Dresser Establishes Washington Office

Dresser Industries, Inc., Dallas, Texas, has announced the opening of a Washington D. C. office, and the establishment of a new governmental department under the direction of Urban Niblo, Brigadier General, U.S.A. (retired).

With offices at 401-08 The Folger Building, the company stated that this was in step with the continued expansion of Dresser's world-wide foreign operations, as well as its domestic government activities.

Personnel Changes At Fairbanks, Morse

Fairbanks, Morse & Co., Chicago, Ill., has announced a number of changes in their factory and sales organization.

Mr. L. A. Weom, who has for the past several years been Manager of Materials and Schedules at the Beloit, Wisconsin, Works, has been appointed Manager of the Pump Sales Division with headquarters at Kansas City, Kansas. Mr. Weom succeeds the late Tom E. Woodruff.

J. R. Walsh, who has been Manager of the company's Kansas City, Kansas Pump Works since its opening several years ago, is succeeding Mr. L. A. Weom at the Beloit Works as Manager of Materials and Schedules.

G. R. Anderson, who has for many years been Manager of the company's Electrical Works at Freeport, Illinois, succeeds Mr. Walsh as Manager of the Kansas City Works.

A. H. Hoffman, who has for a number of years been Manager of the company's Westco Pump Works in St. Louis, Missouri, has been appointed Manager of the Freeport Works succeeding Mr. G. R. Anderson.

Mr. V. E. Johnson has been transferred from the Sales Division to the Manufacturing Division, and has been appointed Manager of the Westco Works in St. Louis succeeding Mr. Hoffman.

Richard Carlson Named By Neptune Meter Co.

Neptune Meter Co., New York, N. Y., has announced that Richard W. Carlson, Jr., of 1507 S. Grant St., Aberdeen, S. Dakota, has been named sales representative for North and South Dakota.

Mr. Carlson will be charged with the distribution of Neptune water meters to municipal and private utilities and petroleum meters to fuel oil distributors and jobbers in the two states.

Prior to joining Neptune Mr. Carlson was in the sales departments of Procter and Gamble Distributing Co., and the Federated Mutual Insurance Co., in Aberdeen, S. Dakota.

Born in Duluth, Minn., in 1928, Mr. Carlson attended Central High School and the University of Minnesota. His military service was with the 4th Signal Battalion of the 25th Division from 1946 to 1948 and from 1950 to 1951.

Gar Wood Appoints Hager

Gar Wood Industries, Inc., Wayne, Mich., has announced the appointment of Joseph R. Hager, Jr. as Director of Manufacturing. Hager was formerly associated with Baldwin-Lima-Hamilton Corp., and held the position of Works Manager of the firm's transportation division. Hager had been with Baldwin in Eddystone, Pennsylvania since 1932. In his new capacity, Hager will direct manufacturing activities at Gar Wood Industries' plants in Wayne, Michigan; Findlay, Ohio; Mattoon, Illinois and Richmond, California.

Drastrup Appointed Vice President, Joy Manufacturing

Joy Manufacturing Co., Pittsburgh, Pa., has announced that A. B. Drastrup has been appointed Vice President of the Company. Mr. Drastrup formerly was President of the A. M. Byers Company.

Born November 2, 1903, Mr. Drastrup studied business administration and accounting, and economics at the University of Copenhagen and the University of Indiana. Before being elected President of the A. M. Byers Company

"Our ROYER has eliminated our last major plant problem"

*from an Ohio sewage treatment plant**

This sewage treatment plant had a problem of sludge disposal. The cost of incineration was prohibitive and the sludge could not be disposed of in caked form as fertilizer, even without charge.

In April 1954 they purchased a Royer Sludge Disintegrator and during the first seven months of operation earned 90% of its cost. They are currently selling their entire output of completely shredded, pulverized, trash free, ready-to-use fertilizer at $5.00 per cubic yard. In addition to replacing a cost of disposal with a cash income, they have built up good will with the citizens of their community by supplying an easily handled, useful fertilizer at a moderate cost.

Write for details on this "income producing" equipment. Available in capacities from 1 to 150 cubic yards per hour in electric motor, gasoline engine or belt-to-tractor drives. Turn an "expense" item into a "profit" with a Royer.

*name on request

ROYER foundry & machine co.

170 PRINGLE ST., KINGSTON, PA.

ROYER

in 1954, Mr. Drastrup was an accountant with the Indiana Steel Company from 1926 to 1928, and held a similar position with the Columbia Steel Company from 1928 to 1931, at which time he joined the Byers Company.

Hirsh Promoted By Lock Joint

Lock Joint Pipe Co., East Orange, N. J. has announced that Philip R. Hirsh, formerly Vice President in charge of sales, was elected Executive Vice President of the company.

Mr. Hirsh, a resident of Montclair, N. J., has been associated with the company in various capacities since 1934. More recently he has specialized both in production and sales.

Neptune Meter Names Barrington

Neptune Meter Co., New York, N. Y., has announced that John W. Barrington of Valparaiso, Ind., has been named a sales representative for the company in Northern Illinois and Northern Indiana.

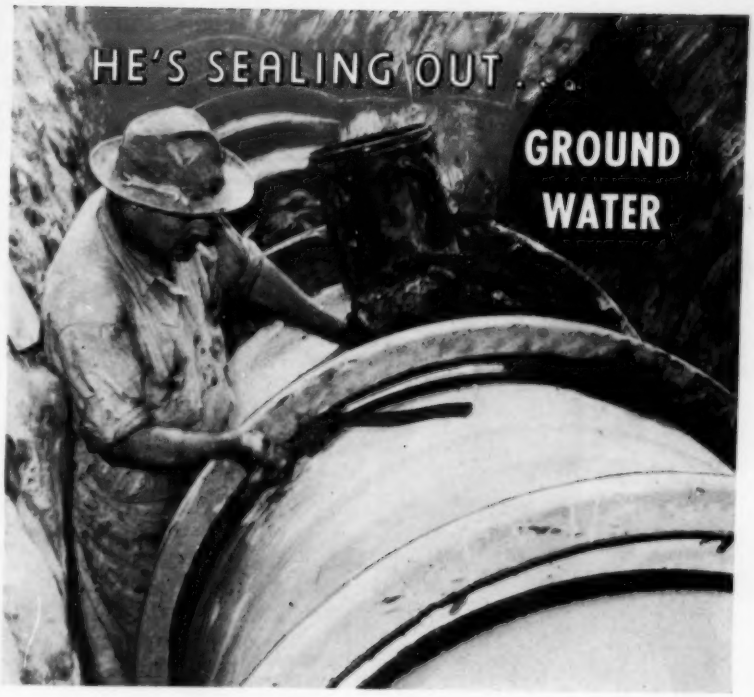
Prior to joining Neptune, Mr. Barrington was in the meter department of the Department of Water of Valparaiso and later had been in the inspection division of the Gary-Hobart Water Corp., in Gary, Indiana.

Born in Valparaiso in 1930, Mr. Barrington attended Valparaiso Senior High and completed his military service from February 1951 to January 1953.

Koehring Appoints Flaherty Co.

Koehring Company, Milwaukee, Wis., has announced the appointment of The Edward C. Flaherty Co. as its new distributor in Lower New York State to succeed the R. E. Brooks Company. The new distributor has complete sales, rental and service facilities located at 43-87 Vernon Boulevard in Long Island City.

The Edward C. Flaherty Co. is well established in the New York area. John P. Flaherty, son of the firm's founder, is a partner and general manager of the operation. Territory to be covered by the newly appointed distributor includes that portion of New York south of, and including the Counties Sullivan, Ulster and Dutches.



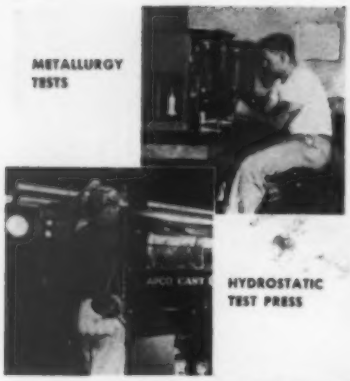
...with Presstite's
3-STEP SEWER SEALING SYSTEM

To keep ground water infiltration out, and prevent sewage overload, this installation is getting Presstite's full, **watertight** treatment.

1. **PRESSTITE PRIMER,** painted on bells and spigots 24 hours before laying, greatly improves bond between pipe and joint sealing compound.
2. **ROPAX®** (shown being caulked in), a non-porous adhesive packing, provides additional joint sealing material. When packed into the bell, it forms a solid, dense seal impervious to water passage.
3. **KALKTITE,®** a cold-mixed, cold-applied joint sealing compound, used to fill the balance of bell. Sets up **internally** under the most adverse conditions. Forms a dense, tough, flexible seal.

WRITE for detailed catalog "3 Steps to Tighter Sewer Joints"

PRESSTITE Sealing Compounds
PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY
K A P
A Division of AMERICAN-MARIETTA COMPANY
3780 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI • 101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS



APCO

NOTHING OVERLOOKED!

Produced in a plant as modern as tomorrow . . . Most exacting metallurgical, chemical and physical tests. . . Strict quality control from the raw material to the finished product . . . That's Alabama's Super De Lavaud Cast Iron Pipe.

For long years of dependable, trouble-free service . . . specify Alabama's Super De Lavaud Cast Iron Pipe. Sizes 3" to 24" in modern long lengths. Bell and Spigot, Roll-on-Joint, Flanged, and Mechanical Joint.

ALABAMA PIPE COMPANY

General Sales Offices
ANNISTON, ALABAMA

We Invite Inquiries to Our Nearest Sales Office

122 S. Michigan Ave. Chicago, Illinois
350 Fifth Avenue New York 1, New York

Schultz Machinery Company Named Bucyrus-Erie Distributor

Bucyrus-Erie Co., South Milwaukee, Wis. has announced that Schultz Machinery Company, Bismarck, N. D., has been appointed distributor in North Dakota for the company.

The Bismarck firm now offers sales and service on the full line of ⅜- to 4-yd. convertible excavators and cranes; 15-ton and 25-ton capacity Transit Cranes; ⅜-yd. and ½-yd. truck-mounted all-hydraulic Hydrocranes; and dragline buckets.

In serving the entire state of North Dakota, the new distributor maintains complete equipment servicing facilities at 1505 Main Street, Bismarck, N. D. A branch office is located at P. O. Box 669, Minot, N. D.

"MAN in the IRONMASK": There's got to be a better way of making a living!

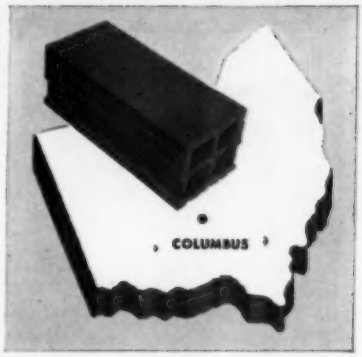
Caldwell Joins Pittsburgh Coke

Pittsburgh Coke & Chemical Company has announced the appointment of John H. Caldwell as a salesman in the firm's Protective Coatings Division.

Mr. Caldwell, who will handle sales of the company's cold-applied coatings in the Gulf States area, had formerly been associated with S. D. Day Company, Houston. During World War II and the Korean outbreak, he served in the U. S. Air Force. He was a flight commander in the Strategic Air Command.

A member of the Houston Engineers and the NACE, Mr. Caldwell attended the Naval Academy Preparatory School and Iowa State Teachers College.

Another NEW Leopold Installation...



New 48 mgd Columbus, Ohio plant equipped with Leopold Filter Bottoms

In addition to this recent installation, Leopold Compound Duplex Filter Bottoms are giving dependable, economical performance in well over 300 plants (with a daily capacity of more than 1¼ billion gallons). And the number of Leopold-equipped facilities is growing by leaps and bounds. For example, Leopold Bottoms have been specified for the five largest plants now being built in this country.

Whether you're modernizing your present plant or planning new construction, it will pay you to consider the many features offered only by Leopold Tile Filter Bottoms. They resist corrosion, are not subject to tuberculation, require only small sized gravel, are acid and alkali resistant, provide equal and uniform filtration, and will last indefinitely. Want more details? Write us today.

For TOP performance, use Leopold Bottoms

Leopold

F. B. LEOPOLD CO., INC.
2413 W. Carson Street
Pittsburgh 4, Pa.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT!

Literature & Catalogs

Hydraulic Data Book

611

Leupold & Stevens Instruments, Inc., Portland, Oregon, has available the fifth edition of their **Hydraulic Data Book.**

This well illustrated 140-page data book comes in pocket size (5½ X 8 inches) and is divided into three general sections: (1) Float wells and instrument shelters, (2) Errors in float operated devices, and (3) Hydraulic tables. Eight pages of handy conversion tables are also included.

Photographs of Leupold & Stevens instruments are shown throughout the book to illustrate text material.

Sludge Collector

612

Chain Belt Company, Milwaukee, Wisconsin, has just published a new folder, showing the specifications of its type ME **Conveyor Sludge Collector.** The folder describes the components of the Sludge Collector, and their functional advantages. Photos and line drawings show how the components are used.

Flowmeter Catalog

613

Fischer & Porter Company, Hatboro, Pa., has just published a 16-page catalog describing their new glass tube variable-area **Flowrator Meters.**

The catalog describes in detail the models available, various types of tubes and floats, predictable performance characteristics, construction features, and accessory equipment. A section devoted to extensions and secondary instruments, which can be used with the 1700 series meters, is also included.

Single-Stage Pumps

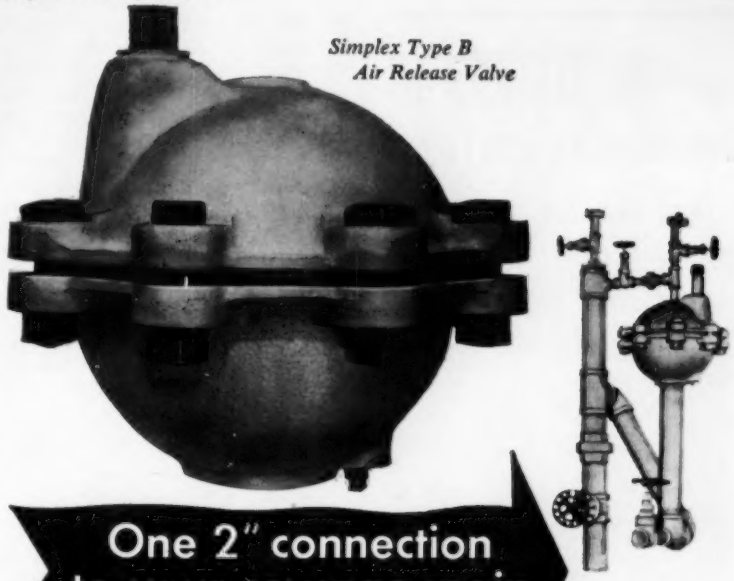
614

Ingersoll-Rand has just released a new pump bulletin, covering their re-designed line of DMV-DHV **Single-Stage Centrifugal Pumps.**

According to the bulletin these pumps are designed for general hydraulic services, and feature double mechanical shaft seals which eliminate stuffing box main-

(*Continued on page* 106*A*)

Simplex Type B Air Release Valve



One 2" connection to your sewage main

cuts pumping costs

Here's the low-cost way to reduce the high costs of pumping sewage. The Simplex Type B Air Release Valve rids lines of entrained air and sewage gases . . . puts an end to binding at high points. It quickly pays for itself by lowering the friction head, increasing pumping capacity. **How you save!** When air and gases collect in the upper valve shell, they depress the rugged ball float . . . automatically opening the needle valve so that all entrained air and gas escape *immediately!*

CHECK THESE ADVANTAGES!

- Reliable! Bronze seat with silicon rubber-tipped valve stem designed to prevent sticking shut or leaking water.
- Rugged! Cast iron shell and non-corrodible float can take pressures up to 250 psig.
- Simple—few parts, just one lever movement.
- Vacuum-holder prevents loss of prime.
- Easy back-flushing with no permanent connection to clear water supply.
- Shipped complete with pipe leg to collect sediment and valve to blow it off.
- Easy to install—just one quick connection.

WRITE FOR BULLETIN 1204
Simplex Valve & Meter Company, Dept. WS-6
7 East Orange Street, Lancaster, Pa.

ACCURATE INSTRUMENTS AND CONTROLS SINCE 1904

SIMPLEX®

VALVE AND METER COMPANY

with **"GUNITE"**

PRESSURE CONCRETE CO.

gives cement greater utility, versatility!

FOR REPAIRING: Reservoirs, Dams, Filter Plants, Sewage Disposal Plants, Tanks, Stadiums, Bridges, Sea Walls, Breakwaters.

FOR LINING: Reservoirs, Swimming Pools, Tunnels, Sewers, Pipe, Concrete, Brick and Steel Tanks, Stacks, Bunkers, Irrigation Ditches.

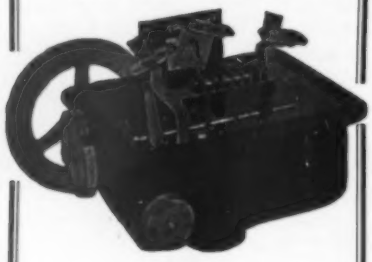
FOR CONSTRUCTING: New Tanks, Stacks, Piles, Sidewalls and Roofs, Steel Encasements.

Write for 48-page illustrated booklet showing "GUNITE" at work.

PRESSURE CONCRETE CO.

NEWARK 5, N. J. 193 Emmet Street
CHICAGO, ILL. 33 No. La Salle Street
CHARLOTTE, N. C. Liberty Life Bldg.
FLORENCE, ALA. 315 So. Court Street

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 Hampden Ave., St. Paul 4, Minn.

tenance, and pre-lubricated, sealed ballbearings which require no lubrication throughout their entire service life. Single mechanical seals are also provided for services where the liquid being handled is clean, and supplied at a positive suction pressure.

Further information on the construction features of these simplified units is included in this new eight-page, two-color bulletin. Also incorporated in this bulletin are typical installation views, cross sectional views, an exploded view of component parts and dimensions. An interchangeability chart is also illustrated to show the maximum interchangeability of parts throughout the entire line.

Centrifugal Pumps

615

Economy Pump Div., C. H. Wheeler Mfg. Co., Philadelphia, Pa., has just published a bulletin describing **Wheeler-Economy Double Suction Single-Stage Centrifugal Pumps.**

According to the well illustrated, 8-page bulletin these pumps are recommended for general service wherever liquids of low viscosity are to be moved. Case is split on horizontal center line and rotating parts can be removed for maintenance without disturbing piping. Cross section drawings and construction details for standard sizes up to 10-inch discharge are included.

Variable Area Flow Meter

616

Penn Instruments Division, Burgess-Manning Co., Philadelphia, Pa., has available a catalog on the **Penn Linameter,** a variable area flow meter.

This profusely illustrated catalog describes the Linameter as an instrument for the direct flow measurement and control of water, steam, air, oil, corrosive fluids, pumps and slurries, viscous liquids, fuel oils and tars, and small flows.

Cutaway diagrams and photographs show the inner workings of the meter. Installation photographs are included and also a capacity table and technical data are given.

Selection Of Automatic Transfer Switches

617

Automatic Switch Co., Orange, N. J., has just published a 16-page factual brochure in color entitled

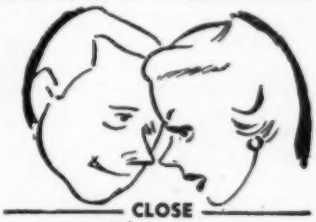
ATLANTIC CITY'S NEWEST CONVENTION HOTEL

The Jefferson with its new facilities for handling all convention groups is fast becoming Atlantic City's most popular convention hotel.

The Jefferson features an abundance of Meeting, Banquet and Exhibition Rooms fully equipped to handle your every need. Experienced personnel. Location ideal in heart of Atlantic City.

WRITE • PHONE • WIRE TODAY FOR DESCRIPTIVE LITERATURE

Convention Manager
Hotel Jefferson
Atlantic City, N. J.



CLOSE *to things in* **Cleveland**

Conveniently located in the heart of downtown Cleveland—just minutes away from everything.

CLEVELAND STADIUM

800 beautifully decorated, spacious rooms and suites—each with private bath and radio. Six outstanding restaurants and bars.

PUBLIC AUDITORIUM

Excellent facilities for Conventions and Special Events.

CLEVELAND BROWNS

Garage open 'round the clock.

ZOO MUSEUMS

SYMPHONY

Room Rates from $4

Hotel Hollenden

Cleveland's Most Interesting Hotel

Superior Avenue and East Sixth Street

ROBERT P. JOYCE
General Manager
Phone: MAIN 1-4700

"Factors to Consider in the Selection of Automatic Transfer Switches".

To simplify specification of this equipment, the ten features required for adequate design are concisely listed—then information is given on why these features are essential.

Additional information included in the brochure covers: Selection of type; How to specify the switch capacity; Calculating line currents; and a suggested specification for automatic transfer switches.

pH Equipment Applications For Water And Wastes

618

The Bristol Co., Waterbury, Conn., has released two new data sheets covering applications of **pH Equipment In Water Treatment And Waste Disposal.**

The data sheet on water treatment application covers a general review on the problems and treatments involved, and then goes into more detail on the instrumentation requirements as applied to municipal water plants, industrial process use, and boiler feed water applications. The waste and sewage disposal problems are treated in similar fashion.

Line drawings of typical control systems, and photographs of an actual installation in Bridgeport, Conn., illustrate the sheets.

Bearing Catalog

619

Chain Belt Company, Milwaukee, Wis., has published a new 72 page Catalog on **Shafer Self-Aligning Roller Bearings.** The new catalog contains specification and data pages on all models of Shafer units. These various models have shaft sizes which range from ¾" to 7".

The new Catalog describes the Shafer Self-Aligning principle of concave rollers running between convex raceway, the Shafer Micro-Lock Adjustment, and Shafer "Z" Seal, etc.

Included in the Catalog is completely revised engineering data, new load rating tables, exploded view for parts identification, etc.

Chemical Catalog

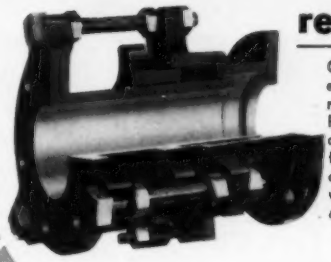
620

Fisher Scientific Co., Pittsburgh, Pa., has just published the 1956 **Fisher Chemical Index.** The catalog lists over 7300 chemicals—everything from "workhorse" tech-

(*Continued on page* 108*A*)

Crispin

SLIP JOINTS ... for fast, safe repairing of lines



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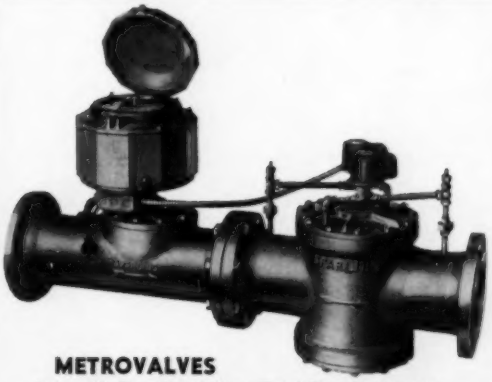

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A handy reference book, it gives structural formulas, formula weights, melting and boiling points, and color-index numbers.

Multicell Filters

621

General Filter Company, Ames, Iowa, has just published a 4-page bulletin on **Multicell Filters.**

Profusely illustrated, the 3-color bulletin discusses the following advantages of the filters: Low cost installation; Non-clogging stainless steel baffles; Lower demand on backwash flow rate; Backwash cells individually, or Filter and backwash cells simultaneously.

The bulletin also illustrates and discusses the GFC stainless steel "Multi-Plate" baffles used in the filters. A complete list of specifications are given on the back cover.

Controlled Closing Air Valve

622

Simplex Valve & Meter Co., Lancaster, Pa., has just published a bulletin on the **Controlled Closing Air Valve,** Type CCAV, that was designed for the protection of pipe lines against surge and built-up pressures or water hammer.

This well documented, graphically illustrated, 12-page bulletin discusses how this device can control the speed of line closure, vent air and, if necessary, discharge water to prevent damage and also limit air to protect against pipe collapse from line breaks. The valve is furnished with a 4 inch and 6 inch diameter flanged inlet opening and is suitable for bolting directly to standard flanged fittings in the pipe line.

Water & Sewage Laboratory Apparatus And Chemicals

623

General Laboratory Supply Co., Paterson, N. J., has just released a 32-page catalog on **Water & Sewage Laboratory Supplies.**

The catalog illustrates each piece of equipment and is divided into sections on Apparatus; Chemicals; Furniture; Photometer Calibra-

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tion; Solutions; and Test Assemblies. A short description, order number and prices are given on each item listed.

"O" Ring Engineering Handbook

624

Plastic And Rubber Products Co., Los Angeles, Calif., has just published an **Engineering Handbook** on "O" rings.

This handbook contains charts, illustrations, graphs and all engineering data in the development of the "O" ring seal, design information on internal and external grooves, gland finishes, chamfers, selection of gland, piston rod, and cylinder materials and lubrication.

Special sections of the handbook deal with silicone rubber products, custom molding, tables of decimal equivalents, temperature conversion table, circumference and area of circles. The new Engineering Handbook also features "Fingertip Indexing" for speedy library reference.

Glass Pipe And Fittings

625

Fischer & Porter Company, Hatboro, Pennsylvania, has just published a catalog describing the company's line of **Glass Pipe and Fittings.** Fabricated from Pyrex Brand glass tubing, these pipe and fittings are primarily designed for laboratory or pilot plant use and other special services. Sizes from ¼-inch to 1-inch, internal diameter, are kept in stock for immediate shipment.

In addition, the catalog describes F&P's new threaded metal couplings for metal-to-glass and glass-to-glass connections plus F&P's high pressure glass stopcocks which are offered in spigot type, two-way and three-way designs.

Diesel Engines

626

Caterpillar Tractor Co., Peoria, Ill., has released a folder entitled **"Two New Engines",** that describes the 310 HP and 200 HP series F engine.

(*Continued on page* 110A)

CEMENT GUN CO. USES "GUNITE"
FOR DISPOSAL PLANT REPAIRS

The top photo shows badly disintegrated concrete Imhoff Tank at a small New Jersey Sewage Disposal Plant. The repairs involved removal and rebuilding of two walls of this tank in their entirety, together with the relining of the tank with two inch "GUNITE."

The two trickling filters were also repaired with "GUNITE" to a thickness of two inches both inside and outside, as well as rebuilding sections of the circular wall. On the interior of the trickling filters the "GUNITE" was carried down eighteen inches below rock line. ..

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W. S. Darley & Co., Chicago 12

The folder discusses the many new Caterpillar engineering and research developments that are incorporated in these engines. A short section is devoted to the many possible engine arrangements that are now available.

Non-Clog Pumps

627

Aurora Pump Division, The New York Air Brake Company, Aurora, Illinois, has just issued a bulletin describing its complete line of **Non-Clog Pumps** for handling solids in suspension.

The 8-page illustrated booklet covers the entire line of pumps of this class manufactured by the company. Included are vertical, horizontal and close-coupled types. Non-clog pumps are used to handle the liquid components of industrial processes, industrial waste, and for such pumping applications as water supply, drainage and sewage handling.

Along with descriptions of the pumps are proposed specifications for the use of architects and engineers.

Flame Cut-Off Machine

628

Speedi-Burn Products Co., Inc., West Hempstead, N. Y., has just issued a brochure describing an advanced new line of **Flame Cut-off and Beveling Machines.**

Typical applications of the equipment to cut-off and beveling operations on heavy utility and industrial piping are illustrated. Also included are specifications, capacities and engineering features of the various models available.

Anti-Rust Paints

629

Speco, Inc., Cleveland, Ohio, has available a new 2-color bulletin describing **Rustrem Anti-Rust Paints.**

Made in the form of a handy self-mailer, it contains detailed information about Rustrem applications, prices and shipping data. Also included are numerous application photos showing both interior and exterior uses.

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Desires a position as manager of a sewage plant or water works, or, both. Also interested in a position as Project Engineer or in sales. Registered Professional Engineer. Experience includes supervising the operations of sewer and water utilities, Project Engineer and Superintendent of construction on various projects and estimating. Box 1139, Water & Sewage Works, 185 N. Wabash Ave., Chicago 1, Illinois.

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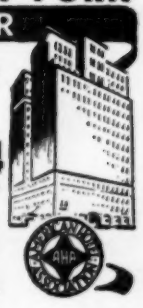

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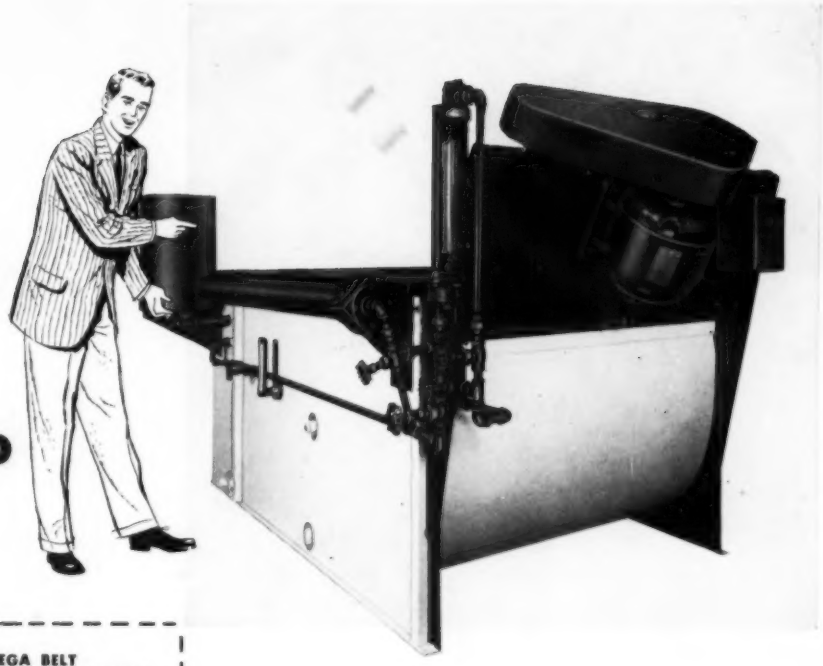
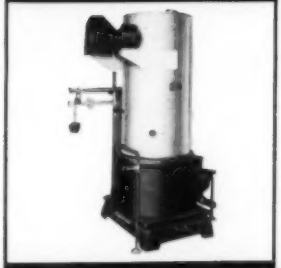


OMEGA BELT GRAVIMETRIC FEEDER

Weighs and feeds lime continuously on short conveyor belt suspended from scales. Adjustable feeding rate from 10 to 10,000 lbs. per hour. Accuracy within ±1%.



OMEGA UNIVERSAL VOLUMETRIC FEEDER

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OMEGA LOSS-IN-WEIGHT GRAVIMETRIC FEEDER

Feeds by unique principle which insures full control and conservation of lime, plus wide adjustability for varying treatment loads. Three models for rates from ½ to 5,000 lbs. per hour. Accurate within ±.5%.

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For thorough slaking that makes the most of every ton of lime you buy, investigate the money-saving advantages of the Omega Lime Slaker. Equally adaptable for use with either Gravimetric or Volumetric Feeders, this basic unit produces a completely slaked, smooth, creamy slurry for easy application. Check these built-in advantages:

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- **Insulated body** and built-in heat exchanger assure peak slaking efficiency.
- **Thermostatic control** maintains high slaking temperatures, yet prevents overheating.
- **Vapor removal device** of adequate capacity protects feeder from hot, dust-laden vapors.
- **Like all B-I-F products,** OMEGA Lime Slakers have consistently proved why "the best costs less". OMEGA'S complete line enables you to standardize on *one* dependable source of chemical feeders. Free yourself from the nuisance and expense of divided service and responsibility.

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twice as fast in half the space

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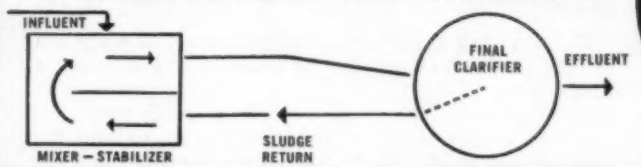
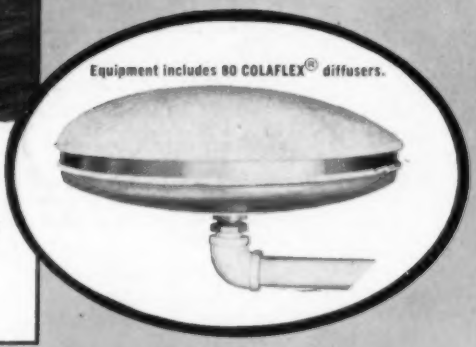
Engineering by Wood & Craig Consulting Engineers, Tulsa, Okla.

FLOW DIAGRAM: DESIGN AVERAGE FLOW 0.39 M.G.D.



Equipment includes 80 COLAFLEX® diffusers.



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Period	Ave. Flow MGD	Average B.O.D. (p.p.m.) Raw Sewage	Final Effluent	% Removal	Suspended Solids (p.p.m.) Raw Sewage	Final Effluent	% Removal
1/14-2/3 '55	0.253	197	18	90.8	225	20	91.0

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